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What Bennett's History of the Panama Canal says about WORTHINGTON PUMPS

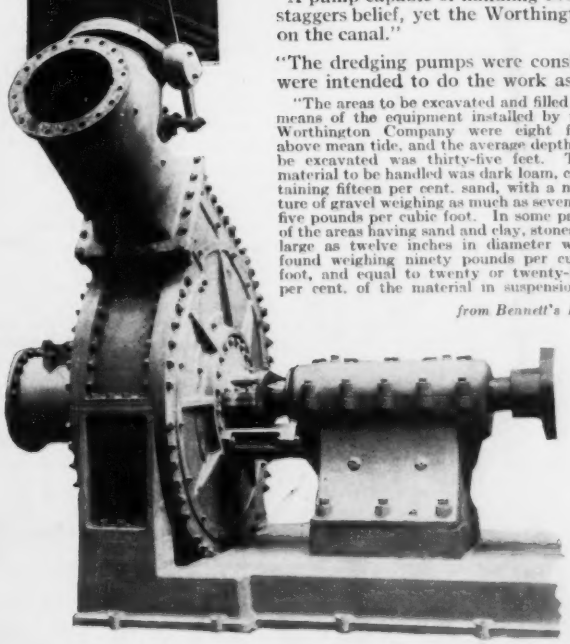
"A pump capable of handling 300 cubic yards of solid matter per hour almost staggers belief, yet the Worthington Company had four such pumps at work on the canal."

"The dredging pumps were considered the most powerful of their kind, and were intended to do the work assigned them in one lift of ninety-five feet."

"The areas to be excavated and filled by means of the equipment installed by the Worthington Company were eight feet above mean tide, and the average depth to be excavated was thirty-five feet. The material to be handled was dark loam, containing fifteen per cent. sand, with a mixture of gravel weighing as much as seventy-five pounds per cubic foot. In some parts of the areas having sand and clay, stones as large as twelve inches in diameter were found weighing ninety pounds per cubic foot, and equal to twenty or twenty-five per cent. of the material in suspension."

"The method of operation was to sink the dredging pumps by stages in the prism to be excavated, until rock was reached, the sedimentary material being mined with the monitors, and sluiced by the dredging pumps. For mining and sluicing, salt water was used through all the pumps. The available power was 3,000 electrical horsepower. The plant was designed on this basis for operating the dredging pump motors. The pumping plant had a capacity of 30,000 gallons per minute, pumping the same through 3,600 feet of main pipe, and 500 feet of branch lines."

from Bennett's History of the Panama Canal.



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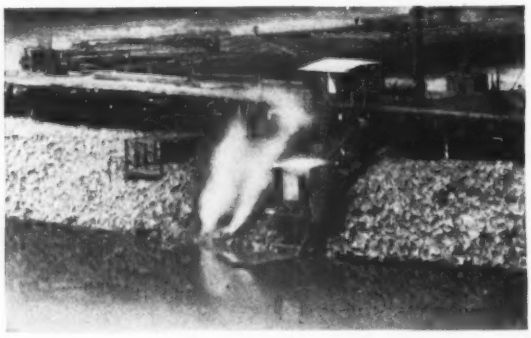
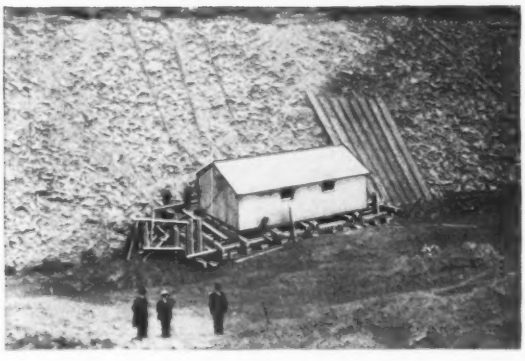
Unwatering the Lackawanna Sheet Piling Cofferdam for the 46th St. Piers, New York City

This work required the removal of about 55,000,000 gallons of water from an area of 300 by 800 feet and inasmuch as the maximum head on the unwatered dam was estimated to be 51 feet, no effort was made to reduce the water level quickly, it being considered advisable to let the dam take a set at intervals.





A 10-in. centrifugal steam pump, capacity 250 g.p.m. was able to reduce the head 6 or 7 inches per 16-hour day. This pump (first small picture) was mounted on skids near the middle of the river side of the cofferdam. These skids and the pump were slid down the steep slope as the pumping proceeded, to keep the pump suction close to the water level. The lowering was done with tackles attached to the Lackawanna Sheet Piling sections in the cofferdam.

An auxiliary pumping plant (lower small picture) consisting of one 4-inch and two 6-inch electrically-driven pumps, mounted on a timber float was also brought into service and operated 8 hours per day.

Unwatering proceeded without special incident until when 13 feet below mean low tide (17½-foot head at high tide) leakage developed from underneath the single row of sheet piles on the 47th Street side of the cofferdam. This leakage was stopped by a novel method.

A 12-inch round timber pile was driven in the old fill back of the crib and pulled. The opening was then filled with layers of earth and sawdust and manure. Plugs of this material were driven down until each whole plug had been driven into the sub-surface and the pile was in its old position. The pile was then drawn and the process repeated from three to twelve times in holes at intervals of two feet.

The leak lasted a week and was of such extent that the 10-in. pump was able to keep a level; that is, from 6 to 7 in. per day apparently leaked into the dam. At last the leak was plugged and pumping continued until when at a level of 15 ft. another leak of the same sort developed. The plugging work as described was continued until no leakage was apparent and the level was down to 21.

Six weeks of pumping brought the level down to 35 feet below mean low tide, at which point rock excavation and construction of a permanent sump were commenced. From that point, the 10-inch pump running days' with one of the 6-in. pumps running nights, kept the leakage down. More recently the leakage has been confined to springs that have been uncovered, and has been easily removed by the 4-inch pump alone.

Inasmuch as the 46th Street Cofferdam is the largest and deepest structure of its kind ever unwatered, the performance here is convincing evidence of the watertightness of the Lackawanna type of interlock and its superiority in subaqueous construction work.

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Engineering News

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Susquehanna Concrete Viaduct Built in Halves

SYNOPSIS—Single-track steel-truss bridge is being rebuilt as two-track concrete-arch viaduct. One longitudinal half was built last season and the old bridge taken down. Contractor's plant fully described. Pneumatic concreting tried, but abandoned in favor of bucket cars. Arch centers described.

Unusual methods are being used successfully in building a 4,000-ft. concrete-arch bridge over the Susquehanna River at Harrisburg, Penn., on a very fast schedule of completion. Until December, 1915, the Cumberland Valley R.R. crossed on a single-track deck truss bridge of twenty-two 170-ft. spans. In its place a double-track concrete-arch bridge of 45 spans averaging 76 ft. is being built on the old piers, with the addition of one intermediate pier in each of the old spans. Traffic must be maintained, and the bridge is therefore built in longitudinal halves. The south half was completed in 1915; the north half will be built in 1916, the steel-truss bridge being now removed. Virtually, two entire 4,000-ft. bridges must be built, each in a single season.

The working scheme of the contractor, the Robert Grace Contracting Co., Pittsburgh, has the following characteristic features: (1) Avoidance of all river falsework under the concrete; (2) handling steel centers in integral spans, without dismounting and reërecting; (3) two concrete-handling methods—bucket cars and air blowing; (4) sheet-steel lagging for the arch intrados and no extrados lagging whatever; (5) tying into the old pier masonry to hold the forms for the incasing concrete; (7) use of steel stringers for the working trestle.

The foundations were built to about low-water level in the fall of 1914, by railroad-company forces; this work included enlarging the footings of the old piers. In the winter the steel-truss bridge was moved 8½ ft. north on the old piers. They were wide enough, having originally been built for double-track superstructure, but fitted with a single-track bridge placed centrally on the masonry. The Pennsylvania Steel Co. did this work successfully, under traffic. At the beginning of the 1915 season, therefore, the bridge was in shape for prompt work on the superstructure. Work began in March.

A controlling feature of the work is the presence of an island about 300 ft. wide in the middle of the river, dividing it into two channels each about 1,600 ft. wide. This island made it possible to place the main mixing plant and shops in a central location. A trestle siding leading off the bridge track was built, to enable material trains to be brought in over the bridge itself.

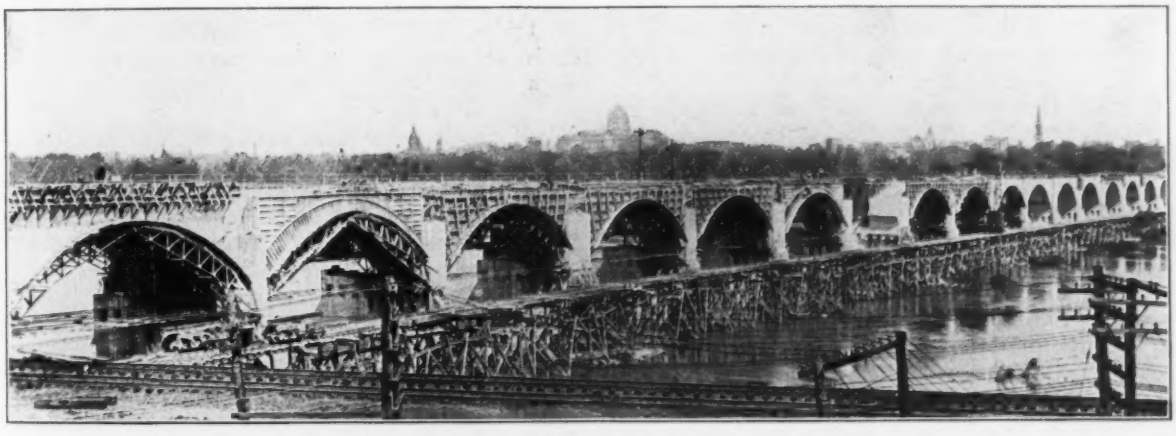
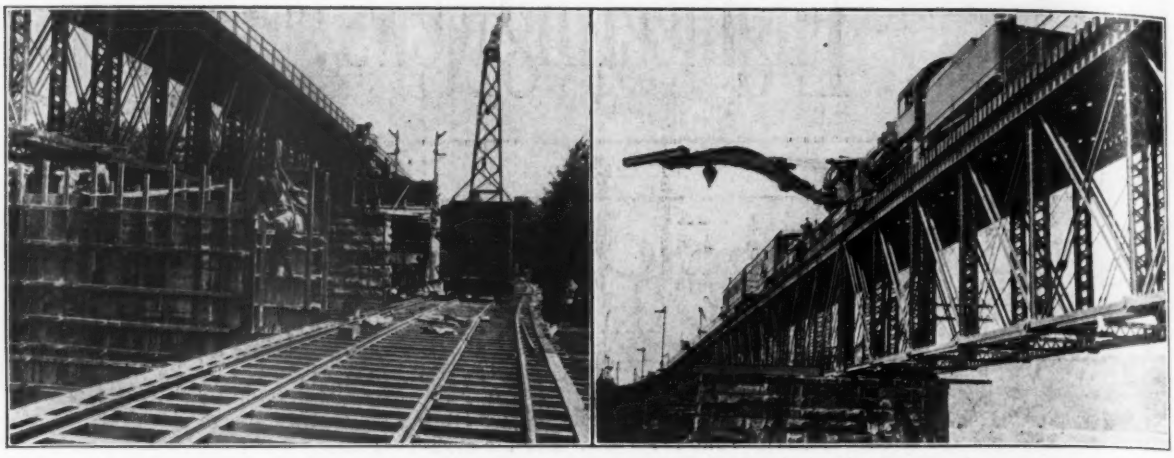


FIG. 1. SUSQUEHANNA VIADUCT AT ALL STAGES OF RECONSTRUCTION

The contractor's plan of procedure for the 1915 work was to carry on all work from a trestle built close alongside the viaduct at an elevation a few feet below the springing line of the arches. Such a trestle would be necessary in any event. By using it, not only to transport the centers, but also to handle all material, including the concrete, great simplification was secured.

All hoisting was done by a pair of 7½-ton McMyler-Interstate locomotive cranes of 37-ft. height of reach, running on the trestle. Centers were transported bodily, one complete span at a time, on cars running on the crane track. Concrete was handled from the mixing plant on the island by Doud Special bottom-gate buckets seated two on a car in two-car trains hauled by gasoline mine locomotives on narrow-gage tracks on the same trestle.



FIGS. 2 AND 3. LEFT—FLOOR OF WORKING TRESTLE; RIGHT—DERRICK ON HALF OF STEEL BRIDGE UNLOADING MATERIAL ONTO TRESTLE

The plan of attack was to begin at the west, or Lemoyne, end of the bridge and work toward the island, having built the trestle across the west channel of the river; then, as the most westerly arches were completed, to move the westerly sections of trestle to the east channel and erect outward from the island, ultimately reaching the east, or Harrisburg, bank by the time the west-channel arches were completed. This scheme gave at all times two or three working points, distributed over both channels, which could be served by tracks leading out in both directions from the mixing plant; and at the same time there was only as much trestle as was required to cover one-half the total length of the bridge.

This ingenious scheme was interfered with by an exceptional amount of high water during the summer, which made it slow work to get at the pier footings, and also by delays at the west bank of the river, in connection with a turnout of the Northern Central R.R. Two supplementary concreting plants were therefore provided to handle work near the west bank:

1. A portable ½-yd. Smith mixer furnished the concrete for placing two shore spans on the west end.[1] 2. A pneumatic conveying, or concrete-blowing, plant was set up at the west bank, to supply some of the river arches independently of the trestle, which could thus be shifted sooner.

The trestle construction was as follows: Six-post bents of four plumb posts and two batter posts, 23 ft. apart on centers; 12x12 caps; 2x6 sash timbers and bracing; four stringers, 15-in. I-beams, one under each rail. These I-beams were in 72-ft. lengths, alternating with 24-ft lengths, the long ones in each case facing an arch span, the short length being at the pier. The lengths lapped past each other without connection. The beams rested on the caps and were held down by rail spikes. Midway between bents they were braced by bridging consisting of plank diaphragms cut in between the beams and a pair of transverse clamping strips above and below the beams, tied together at the ends by bolts. The beams were not punched or fitted in any way, to realize maximum salvage.

The track arrangement on the trestle was such that four rails gave three running tracks, the crane running on the middle pair of rails (standard gage) and the concrete cars on the outer pairs. There being a double turnout from these narrow-gage tracks into the mixer siding, it was possible to keep three trains in service between the mixer and the place of concreting without having a crossover at the delivery end and therefore without constant relaying of track.

The main concreting plant on the island consisted of a pair of bins with a capacity of 250 cu.yd. stone and 125 cu.yd. sand, located under the turnout trestle from the bridge. This trestle held about four cars for successive unloading into the bins. Cement bags were chuted down a slide into a cement house alongside the mixer platform below the bins.

Under the bins the plant was double, with two sets of outlets and gates, each feeding into a four-hopper Hains mixer set to discharge directly into the bucket on the car. Each of the mixers was rated at about 350 cu.yd. per day. The best day's work was 400 cu.yd. for the two.

The plant was located in line with one of the arches of the viaduct, but clear of the structure, on the side opposite the trestle track; thus the track from the mixer led out into the trestle track both east and west.

The individual working section (one span of arch, half the width of the bridge, or a pier lift of ordinary height) averaged between 200 and 225 cu.yd. The plant could supply three or four working sections simultaneously.

Experience with Concrete-Blowing Plant

The concrete-blowing plant comprised bins under the bridge track (filled by dumping cars through the bridge floor), a cement-storage house (cars unloaded by hand to a chute), a McMichael receiver of ¼-yd. capacity, fitted with gates and air valves for admitting air above the charge and in the ejector nozzle below, and 800 ft. of 8-in. blowing pipe. It was possible to lay the latter on the old steel bridge at the edge of the footwalk without interfering with the railway clearance.

The blowing receiver was supplied with air by a 5-in. main laid on the deck of the railway bridge, from a compressor house on the island. This house had two compressors working at 110 lb. per sq.in., with a combined capacity of 1,300 cu.ft. of free air per minute. They fed into three horizontal tanks totaling about 750 cu.ft. capacity, from which the 5-in. main led out. A safety

[1] This work was in other respects also outside the regular working system, inasmuch as wooden centers were used; the work was handled as a job independent of the main portion of the bridge.

valve on the tanks and an unloading bypass on the larger of the two compressors controlled the pressure. Steam was supplied by two 100-hp. boilers, consuming 2½ to 4 tons of coal per day.

Originally ¾-in. stone was used with the blowing plant; but this proved to be not well suited to the work, and 2½-in. stone was later used successfully. Water was fed into the blowing tank by a Lakewood automatic tank (with graduated gage), and the mixture was made with a 5-, 6-, or 8-in. charge of water per batch, just as called for by the foreman in charge of concreting.

At the discharge end the elbow of the 8-in. conveying pipe discharged into a hopper, from which a spout or pipe distributed the concrete over the form; direct discharge into the forms would have been too violent. The elbows in the piping were made of four 22½° bends, giving a quarter circle of 4-ft. radius. This has been found more satisfactory by the contractor than the use of single-length 4-ft. elbows.

The blowing plant saved the labor of two men and the repair and fixed charges of two bucket-car trains; on the other hand, the running cost of the compressor station must be charged against it. Under these conditions the cost of mixing and placing has been distinctly higher for the pneumatic plant than for the main plant, according to the contractor's people. After concreting at the west end, the pneumatic system was moved to the island and placed under the end of the bins. From this location it placed concrete in the bridge east of the island. At neither point was the chuting distance greater than 800 ft.

It is stated that the air plant did not place concrete as economically as was done by the main concreting plant, which was the reason for not attempting to chute beyond 800 ft. From Oct. 1 to Nov. 31 the contractor worked a day and a night shift, using the other mixing plant (with Hains mixers) exclusively. In September and October a total of 8,000 cu.yd. of concrete was placed per month. Concreting the south longitudinal half of the bridge (the first season's work) was finished on the evening of Nov. 31.

Steel Centers and Bracket Supports

The steel centers used for the arches are of the now common three-hinged type, with turnbuckle tie. The spans of the bridge alternate 74½ and 77 ft. in the clear. Instead of trying to adjust the centers to the 30-in. difference by changes in the steel the contractor makes the change to the larger arch by blocking up the circle strips that support the lagging; for the shorter arch the circle strip rests directly on the top flange of the center. There are four centering ribs for the half-width of the bridge, 16 ft.

In the absence of a coping or belt-course to support the arch centers it was necessary either to support them on bents set on the river bottom or to provide some attachment to the side of the pier. Temporary supports in the river being very undesirable, bracket supports were adopted. Pockets were cored in the pier sides to receive these brackets; they were plastered full after the removal of the centers. The sketch, Fig. 7, shows in approximate manner the brackets and the blocking on them to carry the arch centers. The four brackets were braced in pairs.

The centers were cambered 1½ in. above the designed curve of the arch. The turnbuckle tie was not used to hold the thrust of the centering arches under load, but the centers were wedged against the face of the arch stub or umbrella by blocking.

The arch lagging consisted of No. 24 black steel sheets carried by transverse planking separated by 1-in. spaces. In the first few arches concreted the planks were 4x6's, a size having little scrap value. Later the planking was changed to two layers of 2x8, with 1-in. spaces in each layer, the planks of the two layers being staggered or

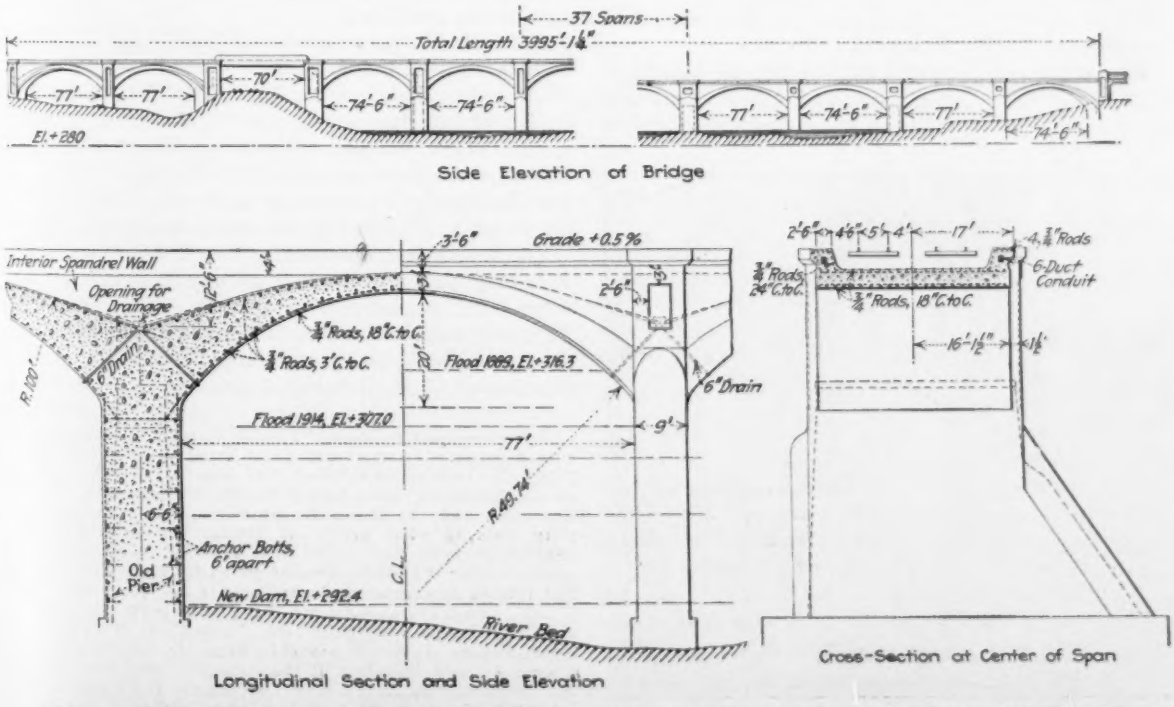


FIG. 4. GENERAL DESIGN AND DETAILS OF SUSQUEHANNA VIADUCT OF THE CUMBERLAND VALLEY R.R.

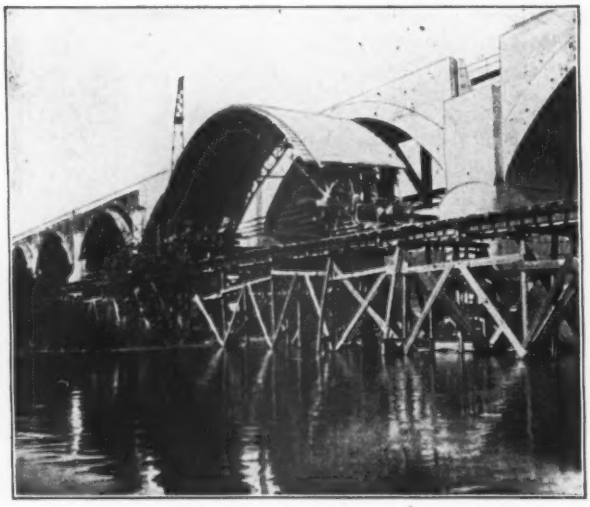


FIG. 5. ARCH CENTER ON TRUCKS BEING PUSHED TO NEW LOCATION

lapped. Spiking these down to the circle strip of the centers proved much simpler than with the 4-in. lagging. Every fourth or fifth strip was bolted through, the intermediate ones being merely tacked together by spikes.

The forms for the spandrel walls were of the sectional type, as were also the side forms of the arch ring and the side forms for the second or main portion of the arch ring (the ring showing on the face is only about two-thirds the inside ring thickness).

The pier forms were tied by ½-in. rods with Universal form clamps in place of nuts. A tin speaking-tube placed over each rod enabled it to be drawn out after stripping the forms. The forms for the enlargement of the old piers were tied to bolts grouted into holes drilled 45° below the horizontal about 18 in. into the old masonry.

The ellipsoidal tops of the pier nosings were formed with 6-in. strips of sheet steel, lapped at their edges, held by nailing to battens at top and bottom.

The arches were concreted without the use of top lagging. The slope of the extrados at the pier, where it is steepest, is about 1 on 3. To make this slope stand in wet concrete required placing a very stiff mixture in the outer portion of the arch. This was spaded to surface. In the first two or three arches concreted, top lagging was used; but after a trial was made of spading the top face with a dry mixture, this method was adopted for regular use, with the approval of the railway company's engineers.

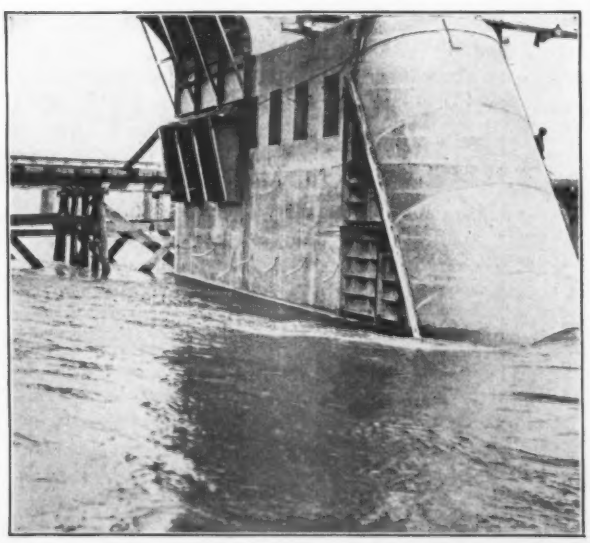


FIG. 6. HIGH WATER AT ONE OF THE PIERS

Arch centers were required to be left in for 30 days, which made it necessary to have six sets of centers on hand. Spandrel-wall work could be done in this period, however. The coping of the outer spandrel wall had to be cast separate from the wall itself, as a six-duct cable conduit was embedded in it. The middle or open side of the bridge, where the west half will join on next season, is closed off by a low spandrel wall, to retain the stone fill and ballast of the roadbed. This wall has no coping.

All surfaces of the concrete were left as they came from the forms. Offsets and honeycombed spots, of course, were made good, but other than this the surface was not touched. The bridge is not accessible for close view, except on the island.

At the close of the 1915 season, during which the south longitudinal half of the bridge was concreted, all trestle material and pier forms were stored for the winter on the island. The 11 centers, on their brackets, were left in place under the 11 arches last concreted. They will be moved upstream in the spring, when concreting recommences. The contractor decided to risk having the centers and the materials on the island washed out rather than incur the expense of removing them to a safer location on the mainland.

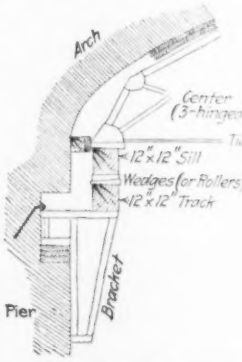


FIG. 7. BRACKET SUPPORT FOR ARCH CENTER

Railroad company forces have filled the arches with rough broken stone. A standard ballasted track was laid on top of the stone (rails are P. R.R. Standard, P. S. section, 125 lb. per yd.). On Friday, Feb. 4, 1916, traffic was put on the concrete bridge, and the steel structure was abandoned. Construction of the north half will begin about Apr. 1, or after the usual spring high water.

The Robert Grace Contracting Co., Pittsburgh, is represented on the job by B. R. Hundley, Supervising Engineer; J. J. Emes is Superintendent in charge of the work. For the Cumberland Valley R.R., Crosby Tappan, Engineer of Construction, is in charge, under the general direction of T. H. Kennedy, Engineer.

The Structural Engineers' License Law in Illinois was discussed by W. C. Armstrong, Chief Engineer, St. Paul Union Depot Co., in a paper entitled "The Relation of the Architect to the Engineer," read before the St. Paul Society of Civil Engineers and the Minnesota Surveyors and Engineers Society, Feb. 12. The architects' license law in Illinois was enacted in 1897; and up to Jan. 31, 1915, there had been granted under it 1,124 licenses, of which 917 were then in force. The Illinois structural engineers' license law took effect July 5, 1915, and 1,169 applications have been made for licenses under it, of which 613 have been granted and 556 are under investigation. It seems probable, says Mr. Armstrong, that after one year's operation of the structural engineers' license law there will be more licensed structural engineers in Illinois than there are licensed architects, although the architects' license law has been in operation 18 years.

Cost of Utility Changes Made To Avoid Interferences

By H. H. Shearer*

Gas, water, traction and electric companies stand in the position of joint tenants with regard to municipalities in their use of the public streets for locating their main-line plants. Each company's relation to the municipality is defined by franchise and ordinance, but there is seldom any clearly defined basis, other than the desire to be fair, to control the cases of plant interference between these companies. The determination of the correct method of estimating the just cost to be charged by an owner when he rearranges his plant to accommodate another company is the subject of this discussion.

It will be assumed that a company building a new plant or a new extension of its existing plant recognizes its responsibility not to jeopardize the existing plant of others and not to put others to any expense as the result of their additional occupation of the street. In short, the existing plants, by virtue of priority, have the right to remain undisturbed; and if they are disturbed, the newcomer must bear the burden incurred because of his work.

Conditions of Change

Different conditions governing the work necessary where the existing plant of one company must be changed or rearranged to accommodate the newcomer may be classified as follows:

A. The existing plant may be shifted without involving the replacement of plant units.

B. Plant units are replaced with units of (a) the same capacity, (b) different capacity.

Units are of the same capacity when they are equally serviceable, have the same potential use and the same life. For example: Two lead-covered cables having the same number and gage of copper wires similarly insulated are of the same capacity even if they differ in their physical type, but any variation in any of the essentials which varies the potential use of the cable creates a difference in capacity. Difference in type must not be confused with difference in capacity, for if there is no change in capacity, the difference in type is of no moment. This will be appreciated when it is remembered that there is no difference in value between two units of the same capacity, but of different types, because each has the same service capacity as the other, hence the same merchandise value. The market value of the now used type determines the value of both types, and the older type appreciates or depreciates from its original cost (and original value) to the value of the now used type. This greatly simplifies the valuation of units of different first cost, but of the same capacity as current prices always measure the value of the unit.

Considering then the conditions under which work is done, as previously mentioned, if we determine the theoretically proper practice to be followed in each case, we can arrive at a working practice to fit each condition. Following the classifications above outlined:

A. Here there is no question of any benefit accruing to the owner; and the other company must bear the entire cost of the change, which is being made for its accommodation. The gross cost will include all miscellaneous material, labor and incidentals, together with the owner's overhead or supervisory charges on such labor as is furnished by him. The net charges will be the gross cost less the value of any of the miscellaneous material recovered by the owner.

B. (a) The necessity for replacing one unit with another of the same capacity may be because of the inability to do the job in any other way or because it is more economical than to change the existing unit. Both conditions permit the same analysis.

The question of a betterment to the owner because of replacement of a partly worn-out unit by a new unit is introduced, and in practice there is always the further question whether this theoretical betterment will ever be realized by the owner. If the betterment is not realized, then it is of no value to the owner.

There can be no question that the miscellaneous material, labor, incidentals and overhead are charges to the second company, and the recovered miscellaneous material is credited as in A.

Regarding the replaced unit, it is theoretically correct to charge the net cost of the new unit to the second company (the net cost is obtained by subtracting from the present cost the present worth of the future recovery value of the unit when it is retired from plant), the recovered old unit being kept by the owner without crediting the recovery value, if any, against the cost of the job. In other words, the second company pays the net cost to the owner of the new unit and delivers the owner's original property, the old unit, to him.

In practice it is difficult to determine the present worth of the future recovery value of the new unit, because both the time when the new unit will be removed and its recovery value at that time must be assumed. The owner must use his best judgment, based on his practical experience, to determine this value.

Instead of trying to determine this figure, the recovery value of the old unit is frequently credited to the second company and the full cost of the new unit charged them. This is a simple adjustment and generally a liberal one, as the recovery value is credited at full value instead of on a present-worth basis.

It must be clearly remembered that this is a practical modification and not a fundamentally correct practice. It would lead to errors if applied to the next class of conditions.

(b) A change in capacity of units replaced may be for one of the following reasons:

1. A larger unit is used, because the owner desires to provide additional capacity in connection with the work. The owner should bear the entire extra cost of the work due to the change in capacity, as the increase is for his benefit; and the job should be charged to the second company, as if similar-capacity units had been used, and the credits adjusted on this basis.

2. A smaller unit is used, because the owner no longer needs to retain the full capacity of his plant. It is very evident that the fundamental principle, as given in B (a), must be applied and that the approximation of crediting the plant recovered to the job and charging out the new unit at full price is not correct. In extreme cases the value of the recovered units might even exceed the entire cost of the work, putting the owner in the position of paying the other company for a rearrangement of the owner's plant made for the benefit of the second company. The recovered units must go to the owner, and the estimated net cost of the new unit must be charged to the second company.

3. One large unit is used instead of restoring two or more smaller units, as an economy for the benefit of the second company. This again emphasizes the necessity of applying the fundamental principle in B (a) and avoiding the error of crediting the value of the recovered units against the cost of the job.

4. An obsolete-type unit is replaced with an approved type of as nearly the same capacity as can be obtained. Here there is no betterment to the owner, unless the obsolete type is defective, in which case the owner should replace it at his own expense. When the obsolete type is not defective, the case should be handled as in B (a).

It is seen that the one consistent principle that can be followed in all cases regarding the replacement of units is that of B (a), namely: Charge the job with the net cost of the new units not to exceed the capacity of the existing units, and make no credits for recovery value of units removed. Because of the ease of confusion in handling the material credits, careful attention must be given each case.

By basing each particular case upon the fundamentals herein given we believe a much clearer understanding may be reached by all who have to handle such matters.

*17 East 9th St., New York City.

Small-City Pavings in Kansas

EDITORIAL CORRESPONDENCE

While there are no paved state or county roads in Kansas as yet, there is probably no other state in which the cities and local communities have made so much progress in paving—and it must be borne in mind that a city in Kansas often means a population of only a few thousand. There is in Kansas no city of 100,000 population, and only four—Kansas City, Topeka, Wichita and Lawrence—with over 20,000 population.

From statistics compiled by correspondence with city engineers the Kansas City (Mo.) *Star* has found that but three towns of more than 3,000 population have no paved streets and that 50 towns have paved streets. Only 14 of the 50 towns have more than 10,000 population, yet 20 of the 50 have each more than 10 mi. of paved streets; and of the 50 towns 23 have less than 5,000 population and two have less than 1,000. Practically all this paving work has been accomplished in the last five years.

These 50 towns and cities have 736 mi. of pavement, not including about 50 mi. of macadam, mostly water-bound, but some oil treated. From numerous editorial interviews and investigation it is safe to say that between 60 and 70% of these pavements are of asphaltic concrete. A great deal of it has been built under the well-known Topeka specifications.

The original Topeka specification pavement was inspected by the writer on Jan. 21 and was found to be in almost perfect condition. But the excellence of this and other similar Topeka street pavements is not so much the result of the specifications as of the very strict supervision of the work and the constant tests and analyses of the mixture to see that it fulfills the specifications.

Most of the other pavements throughout the state are of brick on a 4-in. concrete base. The so-called vertical-fiber brick developed by the Western Paving Brick Manufacturers' Association is becoming popular. Concrete paving as yet has been used to a very limited extent in Kansas towns, although what is probably the smallest community in the country to have a municipally paved street has a half-mile of concrete pavement laid in 1915. This is Glasco, Cloud County, which has a population of only 860.

Many of these small communities make their municipal improvements on a large scale. For instance, Newton, a city of 7,620 population, laid 200,000 sq.yd. of asphaltic concrete last year in one contract, and the county and city engineer, F. E. Devlin, is about to let a contract for an equal amount this year. As county engineer he is also to build the first county-road pavement in Kansas, which will be 20,000 sq.yd. of asphaltic concrete. These pavements are laid under specifications similar to the Topeka specifications, except that Trinidad Lake asphalt is especially provided for. The paving in Newton last year cost $1.18 per sq.yd. for a 4-in. concrete base and a 2-in. wearing surface of asphaltic concrete. Pavements of this type in Newton have been down for 10 yr. without repairs of any kind.

In general, the present year bids fair to be the busiest one yet in the Kansas paving industry. Much of this work is done by local contractors, such as the Kaw Paving Co., Topeka, which enjoys the distinction of having laid the original Topeka specification pavement; but many of the large contracts are let to Chicago and other Eastern firms. In many of the smaller communities the county engineer also acts as city engineer of one or more of the principal towns, but a considerable part of the paving work is handled by consulting municipal engineers whose headquarters are in Kansas City, Mo.

All city paving work in Kansas is done by assessments on the abutting property, and a majority of abutting property owners may cause any street in any town to be paved with material of their own selection. A few object-lesson pavements in each locality are all that is

END OF LELAND ST., TOPEKA; A TYPICAL KANSAS UNIMPROVED STREET

FIG. 1. MILL-FLOOR CONSTRUCTION OF BRIDGE FLOOR

View shows the diagonal subplanking and the transverse floor planks, the latter set on edge. Between the track rails these planks are laid on the longitudinal spiking pieces

necessary to create a very strong public sentiment in favor of paved streets. The accompanying view shows a typical (Kansas) unpaved street in Topeka, as it looked Jan. 23 and as it looks after every rain and when the frost comes out of the ground. It is said that, when a street is paved, the effect in stimulating property owners to make their premises more tidy and presentable is quite remarkable. There is certainly little inducement to do so with a slough of black, sticky mud in front of the houses.

Light Wood Floor for Bridges

A specially light-weight wood floor for bridges where minimum weight is desired consists of transverse planks laid on edge and placed close together, as in mill-floor construction. This form of pavement is adapted particularly to bascule bridges, where saving in weight is important.

Such construction, as used on the bascule span of the Cherry St. bridge at Toledo, Ohio, is shown herewith. On the floor-beams are laid I-beam stringers to which are bolted wooden nailing strips, these varying in thickness to give the proper crown to the roadway. Across them are laid diagonal planks (at an angle of 45°), which are of 4x6-in. material planed to 3¾ in. thickness and spaced 6 in. apart.

Upon this subflooring are laid the floor planks, at right angles to the line of the bridge. They are of hard maple (or beech), sized to 1⅞x3¾ in. and set on edge. They are nailed together at the timber-treating plant in sections 5 ft. long and are toe-nailed to the diagonal planks. In the joints between the sections are placed two thicknesses of three-ply tarred roofing felt. In some cases the planks are 2⅞ in. thick and are not put together before delivery. The floor is mopped with pitch and sprinkled with sharp gravel (⅛- to ¼-in. size). This is ground into the wood by the traffic and gives a better wearing surface than ordinary plank flooring.

The nailing strips and subplanks are of yellow pine, and they, as well as the floor planks, are given a preservative treatment. For the street-railway tracks I-beams riveted between the stringers and trusses carry the rails and also longitudinal spiking pieces, upon which are laid the floor planks between the rails.

This timber flooring with the grain horizontal will not resist wear so well as wood blocks with vertical grain, but it is lighter than wood-block paving and is more durable than ordinary plank flooring. Its weight is

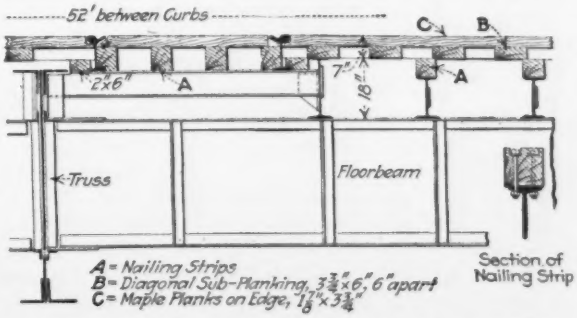


FIG. 2. MILL-FLOOR CONSTRUCTION OF FLOOR FOR BASCULE BRIDGE

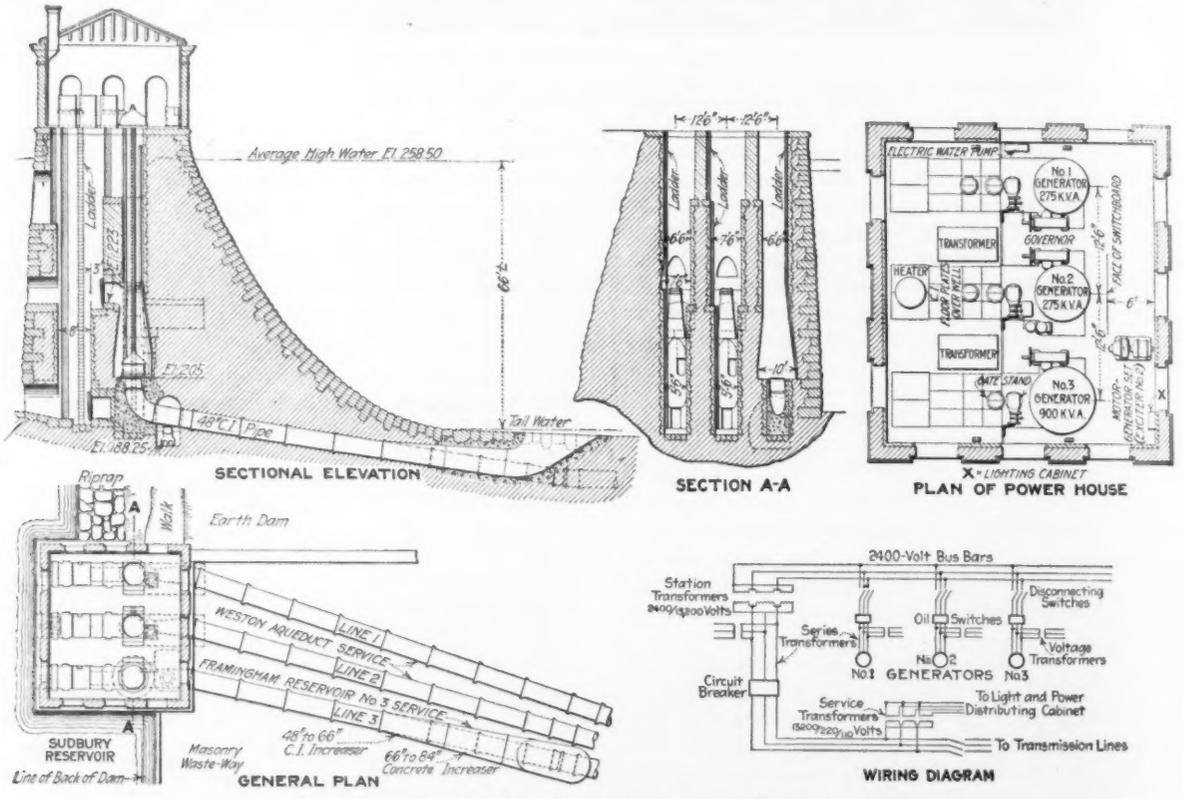
about 20 lb. per sq.ft., including the tar surfacing but exclusive of the subplanking. The mill-type floor construction was designed by the Jennison-Wright Co., of Toledo, Ohio, and all the wood is treated with that company's "kreolite" wood preservative.

Pollution of a Deep Well by surface water was discovered recently at Madison, Wis. The well is furnishing the city's water-supply, and its water has shown a higher bacterial count than that from the other wells. Investigation of the casing showed it to be in good condition. Removal of the flanged inner portion at the top, which carries the suction pipe, revealed a hole, with a small horizontal pipe leading through the concrete cap at the head of the well. The pipe was cut off at the outer side of the concrete and gave free admission to surface water. The original purpose of the pipe is not known, but it may have been a connection to the hydraulic bearing of a former vertical pump shaft. To inspect the well, a bag of flaxseed was lowered about 60 ft.; when it swelled so as to plug the pipe, the water above it was pumped out. The investigation was made by E. E. Parker, city engineer and superintendent of water-works

Power from City Water-Supply at Sudbury Dam

Following the completion and successful operation of the hydro-electric power plant at the Wachusett dam (see *Engineering News*, Feb. 11, 1912, p. 294; Aug. 14, 1913, p. 297; Jan. 28, 1915, p. 169), the Metropolitan Water and Sewerage Board is now installing the machinery of a similar plant to develop power at the Sudbury dam in Southboro, Mass.

Water from the Sudbury reservoir flows into the Weston aqueduct and to Framingham reservoir No. 3, net heads of 37 ft. and 63 ft. respectively being available. The stone gate house at the dam, situated at the northerly end of the spillway, has been arranged to serve as a power station, and in it will be located the turbines, generators, governors, transformers and other necessary equipment. It is expected that the storage of the reservoir will permit the plant to be operated 16 hr. per day, and it is estimated that 3,000,000 kw.-hr. per year will be developed. The rate may be somewhat variable, depending upon the requirements of the water-supply, and may even fall to zero, if it becomes necessary to shut down the power plant.



HYDRO-ELECTRIC STATION AT SUDBURY RESERVOIR DAM

Three complete hydro-electric units are being installed. The wheels are single-runner turbines, with wicket gates and spreading draft tubes, and each is direct connected to a vertical-shaft alternating-current generator. The turbine on the Framingham service will develop about 1,000 hp., and the two on the Weston aqueduct will develop about 300 hp. each. The contract for the wheels was awarded to the S. Morgan Smith Co., the price being $11,760. The guaranteed turbine efficiencies of 84.82% for the reservoir No. 3 service and 84.15% for the Weston aqueduct service were exceeded when the wheels were tested at the Holyoke flume.

The electric equipment includes, in addition to the three main generators, two auxiliary 125-volt shunt-wound interpole direct-current generators to be used as exciters, one 200-volt 3-phase 60-cycle motor and the necessary switchboard, instruments, lightning arresters, etc.

The main generators will deliver 3-phase 60-cycle electric energy at a normal voltage of 2,400. The two generators for the Weston aqueduct service will deliver continuously 275 kv.-a., and the one for the Framingham service will deliver 900 kv.-a., both at 80% power factor with a maximum heating rise of 60° C. The generator voltage of 2,400 will be stepped up to 13,200 volts by two 3-phase 750-kv.-a., oil-insulated self-cooled transformers, and the power will be delivered to the Edison Electric Illuminating Co., of Boston, which has contracted to take it at the rate of $6.25 per 1,000 kw.-hr.

Duplicate underground cables will extend from the power house to a small building about 800 ft. distant, so that the beauty of the dam will not be marred by poles and overhead wires. Lightning arresters will be installed in the small building, from which a single overhead transmission line will carry the power to the Edison lines.

The electric equipment is being furnished by the Westinghouse Electric and Manufacturing Co., at a contract price of $19,349. The plant was designed under the direction of the late Dexter Brackett, as Chief Engineer of the Metropolitan Water-Works, with Frederic P. Stearns as Consulting Engineer; the equipment is being installed under the direction of William E. Foss, Acting Chief Engineer of the Metropolitan Water-Works.

Drainage Canal Deterioration*

By William A. O'Brien†

The ideal prism for a drainage ditch or canal is that which will develop the minimum deterioration or shoaling. The caving of banks to some extent is inevitable, but can be reduced by a carefully constructed section having wide berms and sloping banks.

The U-shaped section is universal within the Mississippi Valley. While a slope of 1 on 1 is generally specified, the work is usually constructed with a U-shaped section having greater bottom widths. The theory is that the slope will break at its neutral point and melt down to its line of repose on a slope of 1 on 1. But this assumption is not representative of slope adjustment on U-shaped sections on low-velocity canals.

The adjustment of slope on the U-section is evidenced generally by a vertical crack some 5 to 6 ft. from the bank line and extending to the medium stage of the channel. This rectangular section slides on its base and finds repose in the channel. The back slope of the void thus formed slacks down to ¾ on 1 or 1½ on 1, filling the unoccupied area in the center of the original prism. The final channel is a wide, shallow, semicircular section. The spoil area is frequently carried into the prism, with corresponding loss. Investigations on this type of section in southeast Missouri indicate that a loss of 40 to 60% in capacity may be expected.

Many dredging contractors believe that floating dipper dredges cannot dig sloping banks where the bottom width is less than 10 to 12 ft. But that they can construct such work with side slopes of 1 on 1, remarkably true to line, has been demonstrated on the work of the Little River Drainage District. We have completed 300 mi. of canals, of which about 200 mi. has 4- to 8-ft. bottom. The deterioration studies being made by the district include the investigation of some 75 mi. of canals in which permanent regimen has been established. The results are of interest in comparison with canals of the U-shaped section.

Caving of Side Slopes Lessened by Flattening

The deterioration in canals with slopes of approximately 1 on 1 is apparently due to the tilting of the seepage plane and the shrinkage of the soil. Relatively small rectangular areas then slide upon themselves, causing the slopes to flatten to about 1½ on 1 and the toes to draw together until they have formed a union. The average loss in capacity is 90%. This suggests that canals having free velocities of from 2.7 to 3 ft. per sec. will maintain themselves. The average scour being 33 cu.yd. per station, and the velocities being lower than noted above, the average silting in the canal is 50 cu.yd. per station.

It is very evident therefore that the sloping bank will reduce the deterioration and that a slope of 1½ on 1 is more desirable than 1 on 1. With a floating dredge it is entirely feasible to construct a slope of 1½ on 1.

If we assume that the runoff provided for is adequate and the roughness factor in the canal is correct, we will have perfect drainage from the theoretical section. If the loss in capacity due to deterioration is 30%, the work is not efficient and will result in financial loss by reason of crop losses, interest and the added increment in the unit cost per yard on the clean-out work. For a channel 6x8 ft. the cost at 7c. per cubic yard is $1,540 per mile. The yardage necessary to be removed to correct the loss in capacity is 6,600 cu.yd. per mile, costing from $800 to $1,000. The net loss to the landowner from this phase alone will be the cost of the clean-out, less the added yardage necessary in the initial construction to allow for deterioration, which will amount to approximately $500 per mile.

Berms of 15 ft. on canals up to 14-ft. bottom may be obtained as easily and cheaply as 10-ft. berms, because in the normal operation of a dipper dredge the spoil should be deposited outside the spud platforms. A canal of 8-ft. bottom and average cutting would require a 1½-yd. machine with 45-ft. boom. This would have about 56-ft. spread of the spud platforms, while the distance between the toes of the slope with a 10-ft. berm specified is only 44 ft. The type of dredge also controls minimum bottom width and maximum curvature.

Obstruction of Drainage Canals

The greatest loss, however, is in the landowners' abuse of the canals by improper open and tile drains, fences across the canals, the appropriation of the canal by willows and other growth and obstruction by bridges.

An open drain only 12 to 18 in. deep will, in seeking its grade line, wash out the berm and form a bar, or shoal, opposite. A tile drain not properly protected by head walls or a galvanized pipe at its end, discharging on a water cushion, will develop the same conditions. The contraction so formed results in a reduction of the carrying capacity, which may extend upstream several miles. In some cases this loss amounts to 60%. An open drain at its outlet should be practically at the grade of the receiving channel, with a uniform approach of 75 ft. For tile drains, 12 ft. of galvanized pipe at the outlet is preferable.

Fences act as barriers to drift and result in shoals from the sunken drift and silt deposit. No practical design of water gate is operative where the velocities are from 2 to 3 ft. per sec., as in drainage channels.

Willows or other growth will very quickly appropriate a channel to a considerable degree, causing a loss in area and increasing the roughness factor, with corresponding loss in discharge. The plowing down and cultivation of waste banks and the cutting of growth on the sides of canals will correct this loss and restore waste land for cultivation. Bridges that tend to retard and collect drift are exceedingly detrimental. Perhaps the worst is the temporary log bridge with short stringers, to afford access to a timber job. Upon the completion of the job the bridge is abandoned, forming a perfect barrier for the collection of drift, with the inevitable shoaling and loss in capacity.

Many state legislatures, realizing the detrimental effect of such conditions, have passed laws making the obstruction of a drainage canal a penal offense. In most cases, however, the land owners do not enforce the statute.

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*Abstract of a paper read at the sixth annual convention of the National Drainage Congress, at Cairo, Ill., January, 1916.

†Chief Engineer, Little River Drainage District, Cape Girardeau, Mo.

Seven Tunnels aggregating 1,000 ft. in length have just been started by the Pacific Gas and Electric Co., near Clipper Gap, Calif. The tunnels are 8 ft. 8 in. in diameter and are for conveying water, for power and irrigation, from South Yuba River.

Design of Darien Radio Towers

By C. A. Carlson*

SYNOPSIS—Why self-supporting towers were selected. Wind load assumed at 30 lb. T-sections expose minimum area to wind and corrosion. Stresses. Bolted field connections. Heaviest loads ever carried on porcelain insulators. Derrick boom falls 500 ft. during erection. Acceptance tests of station assure success of the chain of proposed high-power radio stations.

The rapid development of systems of radio, or wireless, communication capable of transmitting messages over long distances caused the United States Navy Department to realize the military value of a system of high-powered stations capable of communicating with each other and with naval vessels in all parts of the globe. The first high-powered station was built at Arlington, Va., in 1912. Subsequently an appropriation was obtained for a number of stations to be located in the Panama Canal Zone, on the California Coast, in Hawaii, Samoa, Guam and in the Philippines. The station in the Canal Zone, known

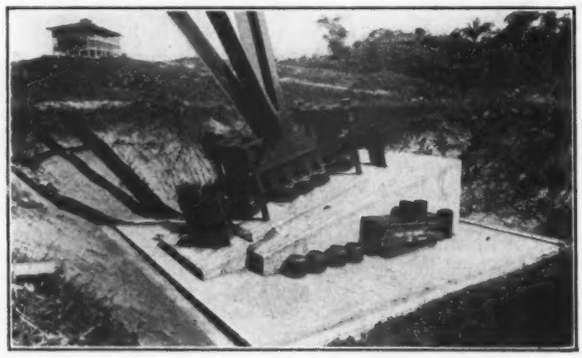

FIG. 1. HEAVIEST LOADS EVER CARRIED ON PORCELAIN INSULATORS

as the Darien station, was the first to be erected with these funds. It was completed sufficiently to permit of operation in May, 1915.

The site of the high-powered station on the Panama Canal was selected after a series of tests made to determine its suitability for radio work. In its topographical features the site was peculiarly difficult. It consists entirely of the steep hills or cones characteristic of land of volcanic origin. The site is bounded by the Panama Canal and by the relocated line of the Panama R.R. The station is about halfway across the isthmus, near a point on the railroad known as Caimito, and across from the point called San Pablo. Officially it is designated Darien Radio Station to distinguish it from the smaller secondary stations, one at Colon and one at Balboa.

Self-Supporting Towers Selected; Design

In determining upon the type of towers to be designed, consideration was first given to the use of built-up wooden masts stayed by guy cables, on account of their low first cost and the rapidity with which they could be erected

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It was soon realized that the decay of timber in a tropical climate would be rapid and that the corrosion of a large amount of wire cable would make the life of such structures very short, except at a high cost for repairs and frequent interruption to the service. Designs were then outlined by the Bureau of Yards and Docks of the Navy Department for a triangular steel mast of the open-lattice type, supported by guy cables throughout its length. Unless unusually high unit stresses were allowed in the guys, they became of considerable size, and with the introduction of so many cables the problem of maintaining them in adjustment and uniformly stressed under varying loadings became serious. It would have demanded of the operating personnel constant labor and attention in keeping the guys in adjustment and the masts in alignment.

From a military standpoint the towers or masts should be as rugged and simple to care for as possible. An alternative design therefore was prepared for a rigid, self-supporting tower. Both designs were for masts or towers 600 ft. high, to be placed in the form of a triangle in plan, the distance c. to c. of towers to be approximately 1,000 ft. A number of bids were received for both types of structures, including proposals for cylindrical tubular masts. The saving in first cost on the guyed masts, while material, was not deemed sufficient to warrant the sacrifice in permanency and safety afforded by the rigid, or self-supporting, type of tower.

The towers constructed are 600 ft. high with a spread of legs at the base of 150 ft. The legs, or base, of the tower extend to a height of 150 ft. A noticeable feature of these towers is the use of the so-called beetle-back system of sway-bracing. All the web members are of rigid section and are designed to take both tension and compression. The use of sway rods is limited to certain interior panels where they are used to stay members in compression.

The sole function of the towers is that of providing a support for an antenna, or aërial, of as large electrical capacity as possible, and with its center of gravity as high as possible. The antenna is composed of a mat of wires in the form of a gridwork of small silicon-bronze wires radiating in a fan shape, and inclosed within a

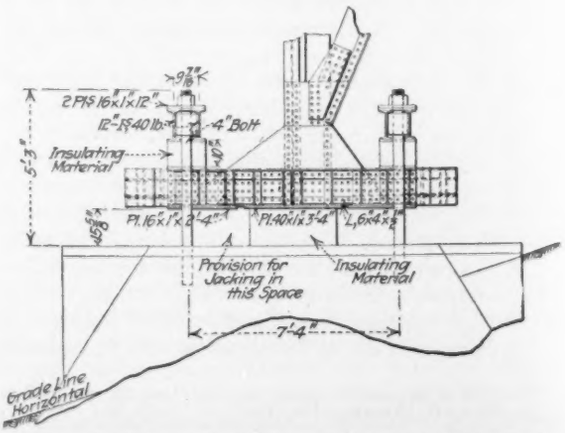


FIG. 2. FOUNDATION FOR TOWER-LEG, DARIEN, C. Z.

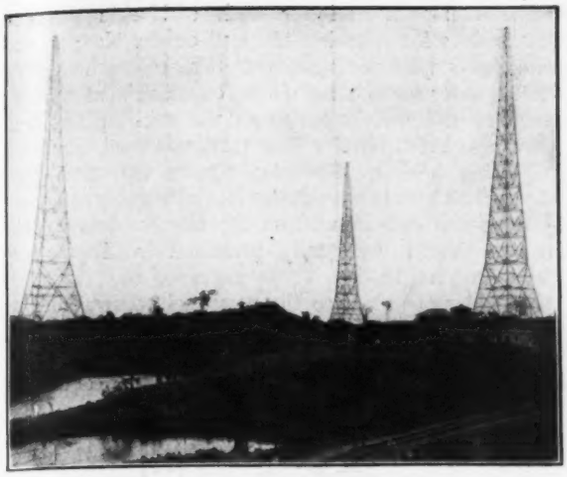


FIG. 3. GENERAL VIEW OF DARIEN RADIO STATION

triangle of supporting cables, forming a fan-shaped antenna. The catenary between each tower was limited to a deflection at the center of not less than one-tenth the span. The antenna forms a triangle with the sides of 920x880x750 ft. The wind load on the antenna and towers was assumed at 30 lb. per sq.ft. of surface normal to the direction of the wind.

Stress diagrams were made for the varying loadings, and the members were designed for the maximum stress that could occur under any possible combination of loadings. The occurrence of the maximum combination of stresses will be very infrequent and of short duration. The wind load is such a large proportion of the total load that for the combined stresses higher unit stresses than ordinarily used were allowed. Members were selected of proper section to meet the following requirements:

Allowable unit stress per sq.in. in compression

$$= 18{,}000 - \frac{70l}{r}$$

Tension lb. per sq.in. $= 18{,}000$

The $\frac{l}{r}$ was limited to 120 in the main columns and to 150 in the sway-bracing. Built-up members of T-sections were selected to obtain members with small exposure to wind, a minimum area exposed to corrosion, and with surface readily accessible for scaling and painting.

The stresses in some of the principal members are as follows: Main leg member C-58, 717,000 lb. compression; main leg member C-47, 658,000 lb. compression; inside leg member A-60, 12,350 lb. compression; diagonal member 47-46, 43,000 lb. tension or compression.

At the base the main columns are built up of a 15x¾-in. web plate, two 5x5x¾-in. angles, a 15-in. 80-lb. I-beam and an 11x¾-in. plate riveted on the web of the I-beam. The section gradually reduces, until it consists of only a web plate and two angles at the top.

Field Connections; Insulated Legs

Principally with the idea of facilitating erection, the specifications allowed the bolting of all field connections, provided the members were assembled and reamed in the shop. The punching of holes not over $\frac{1}{8}$ in. was permitted, the reamed hole to be $\frac{13}{16}$ in. $+ \frac{1}{64} = 0.8281$ in. The use of turned bolts not less than $\frac{12}{64} + \frac{1}{64}$ in. — 0.02 in. in diameter was required for use in case of field bolting. In places where the connections when erected in the field did not comply with the requirements to allow bolting, the contractor was required to use rivets.

The original design of the bases of tower legs did not contemplate the use of any insulating material between the steel bases and the foundations. Provision for an effective spark gap of not less than 10 in. had to be made later when the Navy Department decided that the towers should be entirely insulated from the earth. This meant the taking care of a downward thrust of 750,000 lb., and upon reversal of stresses an uplift of 400,000 lb. All forces acting at the base of the leg would have to be taken care of by interposing between the steelwork of the tower legs and the steelwork of the foundation anchorage some durable material of high insulating properties, combined with high strength in compression.

Glass and porcelain appeared first as the most desirable insulating materials, but no manufacturer could be found in the United States who had successfully made glass insulators of the size and strength required for this work. The only place where glass insulation of this character was being used was at the large radio station at Tuckerton, N. J., where a single steel mast of German manufacture was being erected by a private company. The glass insulators for these towers were made especially for them in Germany.

A design was then prepared for a porcelain built-up insulator, and two large manufacturers of porcelain insulators for high-tension line work made proposals for their manufacture. The insulators are clearly shown in

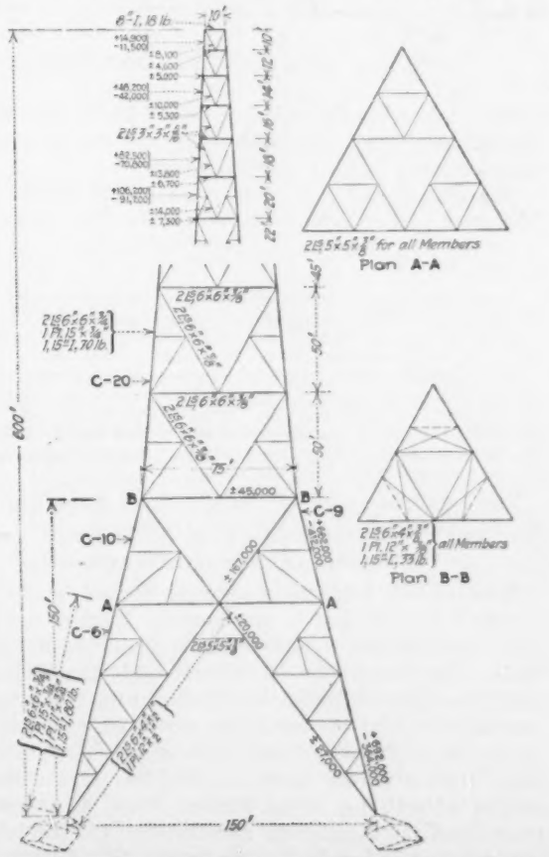


FIG. 4. GENERAL DESIGN OF TOWERS, WITH SOME STRESS FIGURES

the view taken at the base of one tower leg. Each one is built up and cemented together at the factory. Three porcelain disks of petticoat form are placed in the center with a malleable-iron casting at the top and bottom. The whole is thoroughly cemented together with neat portland cement, and the top and bottom faces of the casting are machined. The insulators are 10½ in. high, 10 in. in diameter at the top, 11 in. in diameter at the bottom bearing and 14 in. in diameter over the petticoats. These insulators are believed to be carrying the heaviest loads ever carried on porcelain insulators.

During their manufacture insulators were selected at random from the entire lot and tested for dielectric strength and for crushing strength. They showed very uniform results, standing a difference of potential of

The towers were erected on hardwood blocking arranged with wedges for releasing the load on the blocking and bringing it upon the insulators. The contractor used a wooden tower for the first 150 ft., on which were mounted booms of sufficient length to set the steel leg members. Above the 150-ft. level a long mast was used, the lower end being held by lines leading to the three legs. The middle point in each horizontal strut was shored by a wooden post stepped on the member below. The erection details were fully presented in *Engineering News*, June 24, 1915.

No serious accident to the personnel occurred during the erection of the towers. On the morning of Oct. 22, 1914, while the erecting force was raising column C-18 on leg C of tower No. 2, the brake failed to control the

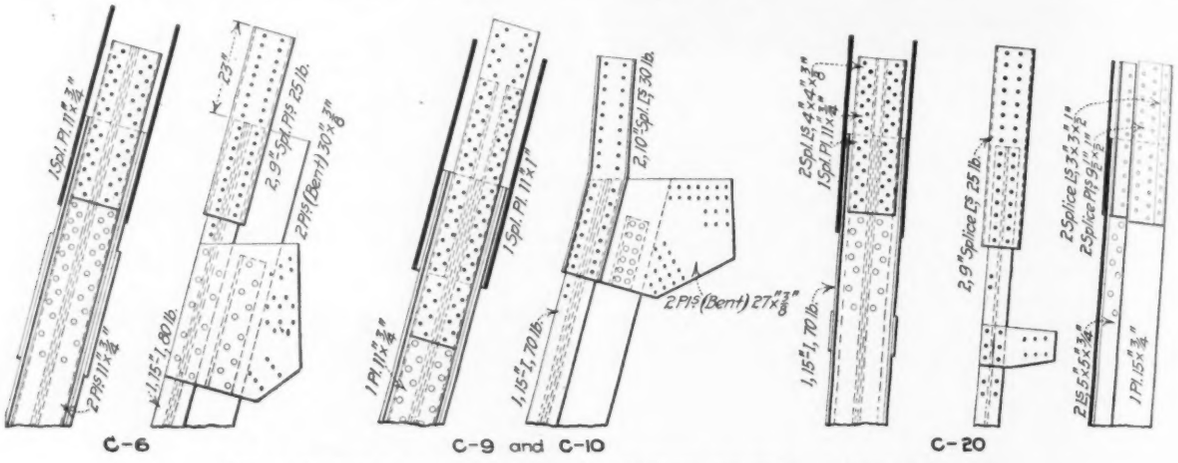


FIG. 5. DETAILS OF THREE OF THE COLUMNS OF THE DARIEN TOWERS

110,000 volts when dry and a wet test of 40,000 volts with insulators inverted, filled with water and subjected to a spray, without flashing over on either test.

The compression tests were made by the Pittsburgh laboratory of the Bureau of Standards. The following is quoted from the bureau's report on a test of six insulators:

> Occasional sounds were noticed commencing in the vicinity of 400,000 lb.; these increased in number between 500,000 lb. and 600,000 lb. At 600,000 lb. (the capacity of the testing machine) the specimens were all intact except for a few radial cracks, extending from the rim toward the center, quite similar to a "craze," but occurring singly. Later, in handling sample No. 1, a piece fell out. It is demonstrated from the tests that the pieces are capable of carrying a load of 600,000 lb. for a short period of time without noticeable signs of fracture, except for a few hair cracks.

The insulators—180 in number—were manufactured by the Pittsburgh High Voltage Insulator Co.

Foundations and Steel Erection

Mass-concrete foundations are used, the weight of each footing being sufficient to overcome the uplift of the leg under the maximum combination of wind and antenna loads. The topography of the site made it a difficult matter to obtain favorable conditions for the footings, so that the thrust of the tower legs would not be liable to cause slides. The top of each foundation is finished in a plane surface normal to the center line of the main column of each leg. The Panama Canal Commission constructed the foundations and installed the insulators under the tower legs by its own forces. The foundation work was described in *Engineering News*, June 17, 1915.

drum that raised and lowered the boom with the result that the boom and load fell. The column, falling end on from a height of about 500 ft., embedded itself over 10 ft. in the ground. The boom fell across horizontal struts 10 and 11 at the 150-ft. level and snapped clean off in two pieces. The boom struck within a few feet of two men

Painting the Steelwork

In the shop the steelwork was painted with one coat of red lead, mixed as follows: 100 lb. red lead, 20 lb. white zinc, 5 gal. raw linseed oil, 3¾ pt. Turp. Japan drier.

After erection, all imperfect paint surfaces were cleaned down and gone over again with one coat of red lead of the same composition as the shop coat. Two field coats were applied, the paint being manufactured in accordance with the following Government forumulas: First coat—red lead (Pb_3O_4), 98% pure, 25%; graphite, 45%; medium chrome yellow, 15%; asbestine and silica, 15%. Second coat—graphite, 50%; medium chrome yellow, 25%; zinc chromate, 5%; prussian blue, 5%; asbestine and silica, 15%.

The great size and weight of the antenna made it necessary to provide power hoists for raising and lowering it. A 12-hp. motor hoist was installed on a platform inside one leg of each tower about 40 ft. above ground. By so doing, the hoist was insulated from the earth by reason of the tower insulation, and the necessity of a separate insulated foundation for each hoist was obviated.

Acceptance tests of the radio apparatus were conducted for a period of more than 30 days and demonstrated the station to be fully equal to all the contract requirements. Since its completion it maintains regular communication in the daytime as well as at night with the Arlington station. Therefore the success of the chain of high-powered stations is already assured.

The entire station was built to meet the requirements of the Bureau of Steam Engineering of the Navy Department, this bureau having cognizance of all radio work in the navy. The designing of the towers, buildings, etc., was done by the Bureau of Yards and Docks. The foundations for the towers, the buildings, water-supply, sewer system, power supply and auxiliary works were constructed by day labor employed by the Panama Canal Commission under the immediate supervision of the officers of the Corps of Civil Engineers, United States Navy, which is connected with it. The steel towers were built under a contract with the Penn Bridge Co., of Beaver Falls, Penn. The power-house machinery and radio apparatus were furnished and installed by the Federal Telegraph Co., of San Francisco, Calif.

Regulation of Excavations in Streets of Houston, Tex.

Some provisions of the city ordinance regulating and governing cuts and excavations in public streets in Houston, Tex., seem rather drastic at first; but the city has recently invested nearly $3,000,000 in new pavements, and it intends to protect them to the best of its ability. Houston has a commission-plan government. The city engineer is E. E. Sands. There are 23 sections to the ordinance. A few of the more important provisions are given in substance:

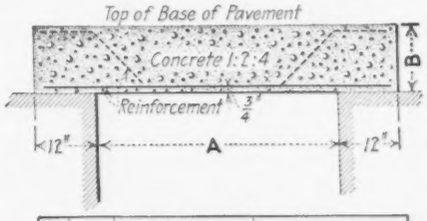
Any person, firm or corporation desiring to make a cut in a street must first file a written application for a permit. This application must contain a detailed description of what is to be done and, except in certain instances, must be accompanied by a plat showing the location of the proposed cuts. Plats are not required for service connections or for excavations for locating trouble in pipes already laid. The applicant for a permit must deposit, as cash or certified check, a sum double the estimated cost of the work.

In streets which have not been graveled, macadamized or paved the trenches may be refilled with moist, damp earth or by means of water-tamping, as the city engineer may direct. When water-tamping is used, the water is turned into the trench after the first 12 in. of backfill has been placed; and then the trench is kept flooded until the remainder of the backfill is put in. When the surface of the ground has been reached, the materials are allowed to settle, the trench is flooded again, refilled to the surface of the ground and again allowed to settle. After this settlement the trench is filled to an elevation slightly above the level of the street. All longitudinal trenches of more than 100 ft. in length must be rolled with a steam roller weighing not less than 6 tons.

On streets that have been macadamized, graveled or shelled the surfacing material must be first removed and kept separate from all other materials. The trench is backfilled as provided for in unpaved streets, but the backfilling must cease at 3 in. below the surface of the street. The macadam, gravel or other material is then replaced and thoroughly tamped and rolled and left at an elevation 2 in. above the remainder of the street. The same provision governs rolling as in the previous case.

If the street has been paved with brick, wood block, asphalt or other pavement requiring a substantial foundation, the trench must be refilled with well-rammed gravel, broken stone or brick-bats, concrete or other material that, in the opinion of the city engineer, can be so placed that there will be no settlement; or the trench may be refilled with earth in the same manner as described for unpaved streets and then covered with a reinforced-concrete slab (see accompanying illustration) at the option and discretion of the city engineer. If thought desirable, the city may do this part of the work and deduct the cost from the deposit on file with the city treasurer.

Another section of interest is that which makes it the duty of every person, firm or corporation owning, using, controlling or having an interest in pipes, conduits, ducts or tunnels under any public highway for any purpose whatsoever to file with the city within 90 days after the passage of the ordinance a map or set of maps on a scale of 200 ft. = 1 in., on tracing cloth, 15x23 in., showing in detail the exact location, size, description, date of installation (if known) of all mains, laterals, services and service pipes and of all valves, pressure regulators, drips, manholes, handholes, transformer chambers or other appliances. It is also made the duty of all persons or corporations having such subsurface structures to file within 15 days after the first of January each year a corrected map or set of maps, on a scale of not less than 200 ft. = 1 in., showing the complete installation of all such pipes and appliances, including all installations of the previous year. Whenever any pipe, conduit, etc., is abandoned, the city engineer must be notified in writing, and the abandoned line must be designated on the file maps for that year.



A	B	Reinforcement	Note
2'	10½"	½"□ Tw. Bars, 8"C. to C.	Alternate Bars bent up
3'	12"	½"□ " " 7" "	
4'	13"	½"□ " " 6½" "	
5'	14"	⅝"□ " " 9" "	
6'	15"	⅝"□ " " 8½" "	

REINFORCED-CONCRETE SLAB USED OVER BACKFILLED TRENCHES, HOUSTON, TEX.

These provisions, of course, do not apply to the city departments, which, however, are expected to live up to them. The penalty for violation of the ordinance or any section of it is a fine of from $10 to $200, and every day in which the ordinance is violated is deemed a separate offense. Before any permit is granted, the following fees must be paid the city engineer: $1.50 for trenches less than 50 ft. long, $3 for trenches 50 to 100 ft. long, $5 for trenches 100 to 500 ft. long and $10 for each 1,000 ft. for trenches over 500 ft. long.

Illinois River Flood

By L. K. Sherman*

The upper Illinois River Valley recently experienced one of the highest floods on record. On Jan. 22, following a long period of cold weather with temperature down to zero, there was a rise to 45°, accompanied by a general rainfall throughout the drainage area amounting to 2 in. or more during a 24-hr. period. Owing to the frozen, impervious surface and the accumulated snow, there was a high rate of runoff. Ice jams were formed at Copperas Creek, Henry and Ottawa. At Ottawa the ice above the Main St. bridge raised the water level 2 ft., flooding the armory and the new high-school building. The Spring Valley bridge was lifted off its bearings.

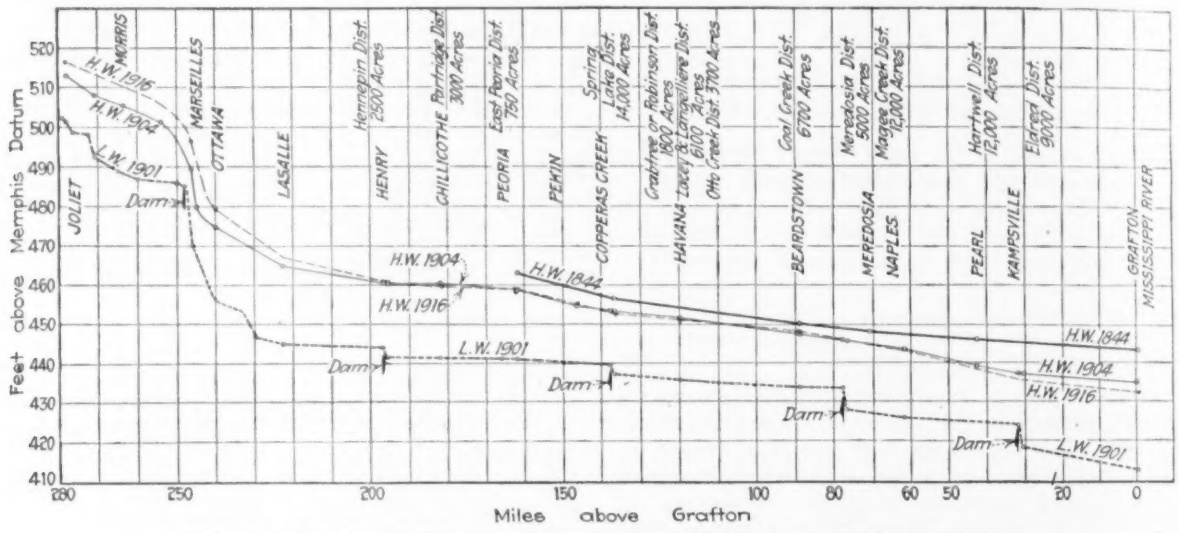
Since 1908 the flood plane of the Illinois River has been reduced 40% by the construction of drainage and levee districts, embracing 172,000 acres. In order to observe the flood effects upon these districts the Illinois Rivers and Lakes Commission assigned F. B. Foote, junior engineer, to the lower Illinois Valley during the high-water period. The Government forecast of a 26-ft. stage of water led the drainage districts to patrol and protect their levees.

The East Peoria levee district was seriously threatened. At the lower end, where the drainage ditch to the pumping station runs close to the levee, the embankment had settled about 2 ft., but vigorous work with sand bags prevented a break. This levee, in general, stood about 3 ft. above high water. Strenuous and effective work was done in protecting the Spring Lake drainage district, of 13,600 acres, between Pekin and Havana. At several points crevasses started. The contractor for the marine railway that is to transport boats over the levee, together with a large force of men belonging to the drainage district, worked continuously during the peak of the flood in placing sand-bag revetment and strengthening the levee, so that very little flooding occurred.

In this same territory the Crabtree levee broke before the flood reached a high stage. The Otter Creek and Spoon River districts were partly flooded from bluff waters.

The Lacy and Langellier districts were carefully patrolled, and sand-bags were collected; but their levees stood up well. The West Matanzas levees were not completed at the ends, and the territory was flooded. Little damage was done, however, as the inclosed land has not yet been reclaimed. Water was kept out until the river reached a 16-ft. stage. Sand-bag dikes were built to prevent the overflow water from cutting out the gaps in the levee.

The Meredosia, McGee Creek, Hartwell and Eldred districts were flooded, the last case being due to uncompleted repairs. The Hartwell levee failed, owing to seepage where the outlet pipe of a former pumping station had been removed. This could not be stopped, and a crevasse of 150 ft. occurred. The levee at Naples, built by the Illinois Rivers and Lakes Commission in 1914, held perfectly and could have safely stood an additional rise of 3 ft. On the upper river the Partridge district levee, opposite Chillicothe, was partly washed out by wave action. The Hennepin district, of 2,500 acres, planted in winter wheat, was flooded and the crop destroyed.



PROFILE SHOWING FLOOD AND LOW-WATER LEVELS IN THE ILLINOIS RIVER

Most of the completed levees built under adequate engineering design were perfectly safe during the past flood. It is the general practice in the Illinois Valley to locate the levees 50 or 100 ft. from the normal shore line, leaving a strip of timbered land as a protection from current and waves. Most of the levees are built by floating dredges, and little attempt is made for finish, except to provide that no part is below the specified grade. The reclamation of overflowed lands by levees and pumping has passed any experimental stage in the Illinois Valley, and the drainage districts include some of the most productive and valuable land in the state, as well as being the most reliable in the uniform production of crops during periods of either flood or drought.

The flood of 1904, which at most places was the greatest flood of recent years, reached the rate of about 80,000 cu.ft. per sec. at Peoria. The flood height of January, 1916, was greater than that of 1904 above Peoria; but lower, downstream. The Mississippi River stood 4.6 ft.

*Member of the Illinois Rivers and Lakes Commission, Chicago, Ill.

lower than during the flood of 1904, when the peak passed Beardstown. Had the Mississippi stood at the 1904 or the 1844 stage, the January, 1916, flood would have been materially greater as far as Beardstown.

The elevation of the highest water of the flood of 1904 and that of January, 1916, are shown on the accompanying profile. The crest of the 1916 flood moved down the river as shown in the table herewith, which gives the time at which the highest water stood at the various points.

TRAVEL OF CREST OF 1916 FLOOD IN THE ILLINOIS RIVER

Miles Above Mouth	Place	Time of Maximum Flood Height	Maximum Flood Elevation, Ft.
265	Morris	11 p.m., Jan. 21	510.42
240	Ottawa	8 a.m., Jan. 22	479.01
223	La Salle	7 p.m., Jan. 22	467.36
196	Henry	6 a.m., Jan. 24	460.89
165	Peoria	7 a.m., Jan. 25	458.92
140	Copperas Creek	6 p.m., Jan. 30	452.75
90	Beardstown	7 a.m., Feb. 1	447.95
90	Beardstown	Feb. 4	447.55
0	Grafton	7 a.m., Jan. 31	434.56
0	Grafton	p.m., Feb. 4	430.00

Owing to the extent of reclamation of the flood plane of the Illinois by the drainage districts and the possible effects upon flood heights, the fish industry and the extensive agricultural interests, the State Rivers and Lakes Commission has had a comprehensive investigation and report made by Alvord & Burdick, consulting engineers. This report is in press. Among its findings are the following:

The average flood expectancy, about once in 50 yr., is a flood about 35% greater than the flood of 1904. Levees should be designed for such flood stage.

The net effect of levee districts now constructed is to increase the maximum flow rate 5%, and when the bottom lands are fully leveed, 10%. Where levees are built upon both sides of the river above the junction of the Sangamon, the distance from center to center of levees should be not less than 1,200 ft., and where reasonably possible 2,000 ft. Below the Sangamon the land is nearly all leveed. The available cross-section for flood waters can be most economically enlarged by increasing the height of the levees.

The Illinois Rivers and Lakes Commission assists projects for drainage and reclamation, so far as may be, by furnishing engineering data or advice. It is the duty of the commission to see that no public streams are encroached upon and that tributary public lakes, useful for flood storage, navigation or fish breeding, are not seized by private interests.

Check Dams in the Mountains of Los Angeles County

By Frank H. Olmsted*

[In *Engineering News* of Feb. 17, Mr. Olmsted described the experimental check dams built under his direction in the summer of 1914 on the mountain torrents back of Los Angeles, to determine the possibilities in flood control, which are being studied by the Los Angeles County Flood Commission. These check dams were built on Haines Cañon, a stream with about 4 sq.mi. drainage area, which in the great flood of 1914 had a maximum discharge estimated at over 2,300 sec.-ft. Concerning the flow from this stream since its regulation by check dams in the storm of Jan. 17, 1916, Mr. Olmsted has written as follows.—Editor.]

There is no indication that this year the flood from Haines Cañon reached at any time over 25 cu.ft. per sec. The storm of January was much less severe than that of February, 1914, yet it rained almost every day in January; and from 11 a.m., Jan. 16, until noon, the Government gage in Western Empire Cañon, a small tributary of Haines Cañon, showed 5.7 in. of rainfall. I, myself, was in Haines Cañon from 11 a.m., Jan. 17, to 3 or 4 p.m., and the highest water had passed from a sharp precipitation occurring about 6 a.m. At 11 a.m., Jan. 17, where the Haines Cañon wash crosses Cedar, the channel was dry, with no water running, although there were evidences that 20 to 25 sec.-ft. of water might have passed at the mouth of the cañon. At 3 p.m. the stream measured 5 cu.ft. per sec. There was no time during January when there was not a stream of at least 3 to 4 cu.ft. per sec. coming out of Haines Cañon; but out of Western Empire Cañon, which had been treated quite thoroughly with check dams two years previously, not a single drop of surface runoff over the cone at the mouth of the cañon where it enters Haines Creek had taken place. There is no doubt that there was a stream under the boulders more or less slowly flowing into Haines Creek. There was certainly no surface storage back of these check dams to account for the absence of any runoff in the bottom of the cañon.

Western Empire Cañon drains an area of 22 acres and has six check dams that cost a total of $200. Its channel, up to the time of the construction of the dams, had been as dry and barren as any desert. There was not a vestige of moisture, except during storms. All last summer, however, there was a small trickling stream in this cañon, and willows and other vegetation were growing rapidly all the way down the cañon.

This winter's test has only strengthened our opinion that the retardation of these torrential flood flows will result in a perennial stream flow where the cañons are properly obstructed by check dams. The ground of these cañons has a greater absorption capacity for water than any of us had hitherto believed possible.

It may be thought strange that there is no runoff from the mouths of these cañons. The explanation is that the water during flood periods ordinarily carried a large amount of silt and slime, which rendered the floor of the cañon almost impervious, so that the water flowed on the surface. When the velocity of the flow is broken by the check dams, there is no erosion of the silt; the water that flows is clear and rapidly sinks into the gravel beneath the stream bottom.

On my last trip into Haines Cañon I noticed a spring of water breaking out in the trail, which has always been dry before, 30 ft. above the bed of the creek. The check dams above had forced the water into the porous soil and the lines of cleavage in the rock, and this water was coming out along the line of least resistance on a dry trail 30 ft. above the creek bed.

*Consulting Engineer, Los Angeles, Calif.

Fees for Surveys of Cache Drainage District of Craighead County, Arkansas, to the amount of $15,652, have been declared noncollectible by the Arkansas Supreme Court on the ground that the district was not legally formed. The act designed to create the district was passed in 1911, and the district was abolished by the legislature in 1913. The Morgan Engineering Co., Memphis, Tenn., was appointed engineer of the district and made extensive surveys. The county refused to pay the warrants of the company on the ground that the act creating the district was void because of an insufficient description of boundaries. Both the Circuit Court and the State Supreme Court held that the contract between the company and the board was void, since the district itself was void.

Long Log and Block Conveyor at Hinckley Dam

By S. Reswick*

The Hinckley Fiber Co., of Hinckley, N. Y., a concern that manufactures pulp for paper, has just completed the construction of a conveyor about 2,000 ft. long on the shore of West Canada Creek in the village of Hinckley, N. Y. This conveyor is to transport logs from the reservoir, formed by a recently completed dam, to the mills located about 2,000 ft. below.

West Canada Creek here is about 500 ft. wide. On account of its location and altitude the New York State Barge Canal utilized the river to feed the new canal at its summit level near Rome, N. Y. For that purpose a masonry dam was constructed at Hinckley, and this created a storage reservoir. The difference of water level at the down side of the dam and the upstream side is 65 ft., or from El. 1,160 to 1,225, and the earth dikes leading to the main dam are 15 ft. higher. It is expected that the water level on the upstream side of the dam will fluctuate between El. 1,190 and 1,230, on account of the necessity of supplying the water to the mills located downstream and also to feed the canal in working season.

Before the dam was built, the Fiber company, in getting its wood supply from timber lands in the Adirondacks, used to float the lumber downstream directly to the mills. After the dam was completed, the logs could not reach the mills by water, and the company built this conveyor for their transportation. The conveyor machinery is mostly of standard type; the unique feature is the inclined section. It lifts the logs directly from the water and carries them to a saw-mill located on top of the slope, from where the blocks are taken to the pulp mills by the horizontal part of the conveyor.

The incline is 150 ft. long and has a slope of 20°. It consists of two parts—one stationary and resting upon concrete piers, the other part movable. The movable part consists of two sections, each 35 ft. long, connected together by hinges. One end of the detached sections is attached to the stationary part, and the other end is suspended on chains from a platform. By machinery and gears it can be raised or lowered according to the fluctuation of water level in the reservoir.

Fig. 1 shows the platform upon which is installed the operating machinery by which the suspended part of the conveyor is regulated. It rests on four rectangular reinforced-concrete piers which, at the present stage of the water level, are submerged under water more than half of their height. The conveyor proper (see Fig. 2) consists of a timber framework and deck supported on concrete piers and carrying three roller log-haul chains and the necessary sprockets, shafting and driving gear; it is driven by a 35-hp. electric motor located in the starter house. The chains run about 86 ft. per min. and deliver 19 logs (from 13 to 20 ft. long) per minute.

Another feature in this construction that is worth noticing is the saw-mill, or as it is called, the slasher house. It stands on top of the slope, as can be seen in Fig. 1. It is a one-story structure with basement. The basement walls are of reinforced concrete; the story above is a wood frame with the necessary openings for belting and the admission of long logs.

All the machinery, as motors, generators, gearing wheels, is installed in the basement, while on the floor above is a gang system of circular saws operated by belting running through the flow from below.

*Assistant Engineer, New York State Barge Canal, Hinckley, N. Y.

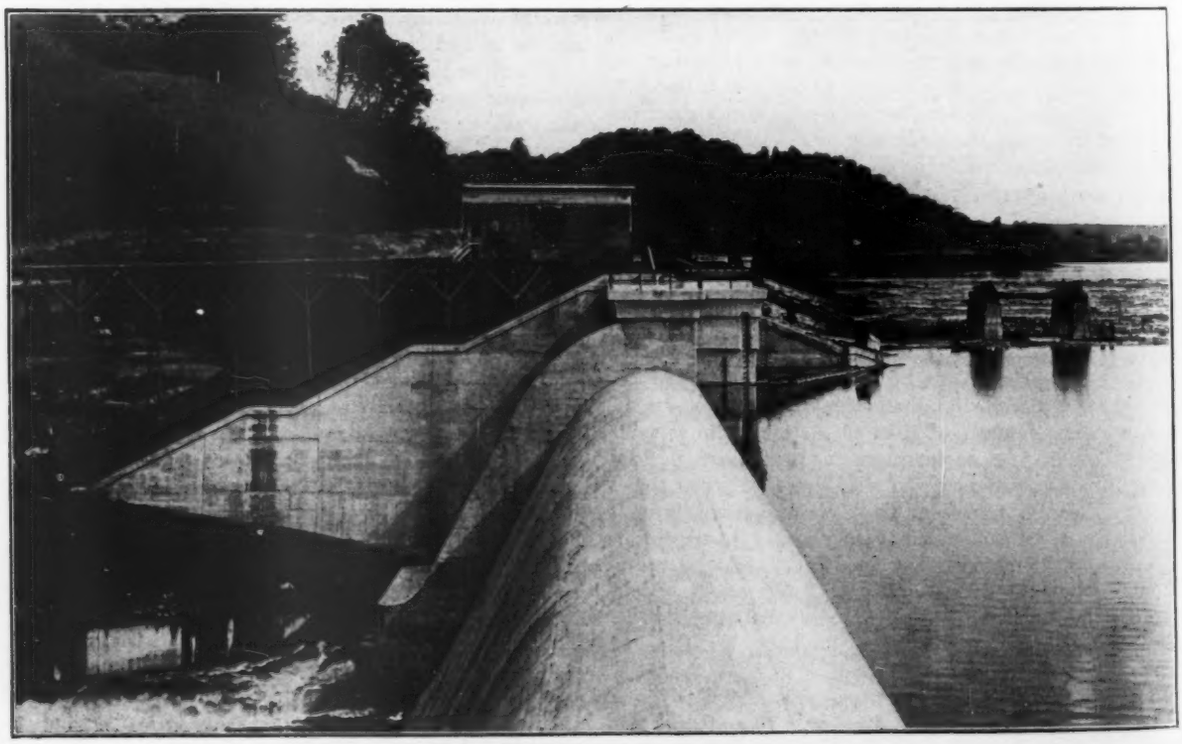


FIG. 1. LOG AND BLOCK CONVEYOR OVER HINCKLEY DAM

As the logs reach the top of the floor, they roll over to a platform, where they are caught on slasher chains and sprockets and carried to six circular saws spaced 2 ft. apart. After passing the saws, the cut-up logs roll out to a short trough conveyor placed perpendicular to the line of the saws. By this they are carried to the men can be found to do the work and do it cheaply and efficiently.

The Peking-Kalgan Ry., a line of 143 mi., which was in the opinion of foreign experts, the most serious and difficult engineering proposition ever undertaken in China, with its steep grades, sharp curves, heavy cuts and fills

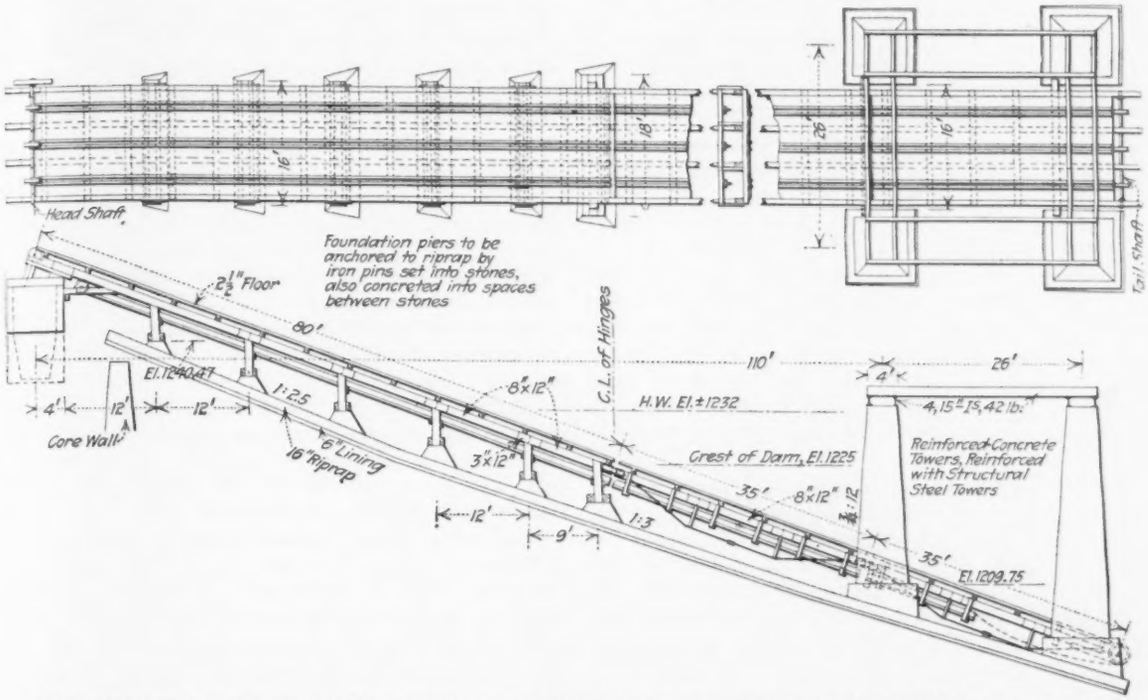


FIG. 2. MOVABLE INCLINED SECTION OF LOG CONVEYOR AT HINCKLEY DAM FOR NEW YORK BARGE CANAL

long, fixed conveyor. This last consists of a large carrying trough and a small return trough with a walk between, all supported by a pole trestle on concrete piers. The fixed conveyor is nearly 1,800 ft. long and is divided into two parts. Each part is fitted up with an endless chain to which are attached suitable flights to carry the wood. It is driven through a double set of gears by a 50-hp. motor in the slasher house.

The capacity of the whole plant is from 250,000 to 500,000 ft. of lumber—taken from the water, sawed up and delivered to the mills in a 12-hr. day. The force required to operate it, besides the machinist and steam engineer, is only eight laborers—two at the water's edge, two in the slasher house, one on the cable conveyor, two at the end of the conveyor and one at the levers.

The plant was constructed by the Hinckley Fiber Co., and the engineer in charge of the construction was C. G. Clinch.

Progress of Chinese Railways*

Europe and America and Japan are training thousands of Chinese engineers and experts. The United States alone is educating today 1,400 Chinese students in engineering, mining, agriculture and other scientific and technical branches. What is most needed in China is capital. Where money is adequately provided, trained and more than a mile of tunnels, was built entirely by Chinese engineers educated in the United States.

The successful completion of this line was all the more significant, because there were not a few foreign engineers who had thought this piece of engineering was an impossible feat. In spite of all these difficulties the cost of construction was under $50,000 per mile, a rate much lower than that on the roads built by foreign engineers in the less difficult regions of the country.

It now brings a net revenue approximately of $4,000 gold per mile annually to the Chinese Government, and this surplus is being used to build extensions, 90 mi. having just been completed.

The Chinese street railway of Shanghai was built and is operated by Chinese. The biggest ironworks in China are managed by Chinese engineers educated in Europe. If further evidence is required, one can point to the big cities in the Straits Settlements, where many of the big business enterprises, such as mining and steamship companies, sugar plantations and banks, have been built up by Chinese energy with astonishing success.

Of the total mileage of railways (6,200) now in operation in China, about 80% was financed by foreign bankers and built with the direct coöperation of the Chinese engineers. With the exception of a few short local lines, they are all making money. The Peking-Mukden Ry., a line of 605 mi., brings approximately a net profit of $6,565 gold per mile per year to the Government, while the Peking-Nankow Ry., 836 mi. long, yields a net revenue of $14,500 per mile per annum.

*From an address by Dr. U. K. Wellington Koo, Chinese Minister to the United States, before the Chamber of Commerce of the United States.

Unusual Water-Works Purchase

By Burt A. Heinly*

SYNOPSIS—Water-works district composed of a part of the City of Los Angeles acquires private water-works, comprising nearly 200 mi. of mains, for $579,080 as against owner's original price of $1,407,151. Some of the property included in the latter figure was omitted from the purchase, and no allowance was made for service connections, meters, paving, going value and good will. The negotiations for the district were conducted by the Board of Public Service of Los Angeles, which will supply water from the Los Angeles aqueduct.

On Jan. 18, 1916, a water-works district created within the City of Los Angeles, yet wholly distinct from the municipality as a bonded district, voted bonds for $1,020,000. The proceeds from the sale of the bonds are to be devoted to the purchase, improvement and extension of the private water-works systems now serving the territory.

The water-works district voting the bonds includes the territory of Hollywood and its environs, comprising not only one of the most exclusive residence districts of Los Angeles, but also well-built business streets and an area of modest homes of wage earners and clerks. The area is about 11.5 sq.mi., and the population is about 60,000. Until July, 1915, the district was served by three private systems, all pumping from wells: The Hall-Bretherton and the Colegrove, each with about 200 service connections, and the Union Hollywood, with nearly 200 mi. of mains, five pumping plants and over 10,000 services. The pipe lines of the first company were taken over *in toto* by the city on a deferred-payment plan. City water was turned into the mains; and this service will, if desired, pay for itself out of its own rates in a short time, as the rates are twice those charged on the city system. Negotiations with the owners of the Colegrove system have not been undertaken, and it is possible that the lines of the company will be paralled.

The pipe lines of the Union Hollywood, which is the only system of consequence, are at present operated under lease from the owners, with option to purchase at a price of $579,080. The original price demanded by the owners was $1,407,151.

Powers of Board of Public Service

For a proper appreciation of what follows, it is necessary to explain that the Board of Public Service Commissioners, which carried on the negotiations for the city, comprises five members, appointed by the mayor, and confirmed by a majority vote of a council of nine members. This board has the expenditure of its own revenues and the management and operation of the Los Angeles aqueduct—both water and power—the city distribution system and the sales of power and water.

This board for some years refused to compete with the Union Hollywood Co. in its territory, which was annexed to Los Angeles in 1910. This position was taken for the reason that the municipal supply obtained from the Los Angeles River was not deemed adequate to serve additional territory. The Union Hollywood Co., pumping from wells, charged a minimum of $1.10 per month for 800 cu.ft. and 11½c. for every 100 ft. additional, as opposed to the municipal rate of 7c. per 100 cu.ft., with a 75c. minimum. Although the company's rate was attacked in the courts, it was successfully upheld as equitable. The water-supply was good, but not wholly adequate; and for these summers it was necessary for the company to purchase from the city as much water as the city was able to spare. This was as far back as 1911. In 1914, four months before the pipe line bringing the aqueduct water into the city was completed, the commission served notice on Mr. Heyler, manager and largest owner of the company, that with a copious water-supply now on hand, the city fully intended to supply his district.

Mr. Heyler called on William Mulholland, chief engineer of the municipal works, to suggest that a board of three appraisal engineers be appointed under the usual rules of such choice. Mr. Heyler was told that the city would agree to this, but that the more practical and certainly the cheaper method would be for himself and his superintendent to prepare an itemized statement of his price. The city, with its own engineers, was to do likewise, the understanding being that the city should take over all such pipe lines and properties as were actually required to distribute the gravity supply.

Cost Estimates by the City and the Company

On Apr. 1, 1914, Mr. Heyler filed his report. On May 5 the city began its appraisal of the system, the Hollywood officials by invitation accompanying the field engineering party. This investigation extended over 45 days, and on account of its low cost the itemized figures are here appended:

Field Expense:		
Labor		$783
Motor truck		180
Superintendent		192
Resurfacing streets		450
		$1,605
Office:		
Two engineers, 30 days	$200	
One engineer, 5 days	30	
One engineer, 5 days	16	
Superintendent	60	
Maps, etc.	30	
	$336	
Total field and office expense		$1,941
Supervision and overhead, 2½%		48
Total cost		$1,989

Comparative figures of the two appraisals are as follows:

	Hollywood Co. Valuation	City Valuation
Main pipe lines (1,090,876 ft. of 2- to 24-in.)	$713,017.35	$447,578.00*
Services	88,941.73	86,904.00
Meters	78,732.95	76,366.00
Land (with water and water rights not appraised)	216,320.00	.....
Reservoirs	40,929.35	.....
Pumping plants and wells	159,880.73	.....
General equipment	14,374.63	.....
Miscellaneous property	6,458.87	.....
Rights-of-way	10,000.00	.....
Liability insurance during construction	18,495.44	.....
Goodwill and going value	60,000.00	.....
Total	$1,407,151.05	.....

*Including cost of paving, estimated at $103,983 (which was not allowed), pipe-line appraisal amounted to $551,561.

*645 South Olive St., Los Angeles, Calif.

The city's offer was $476,000. This was based on a payment of $447,578 for the pipe lines; office records, operating equipment and supplies made up the remaining $28,422. The owners of the property, while frankly accepting the city's appraisal of their property as fair, refused the offer on the ground that the Public Service Board was proposing to buy only a part of the property and was confiscating the remainder that it proposed to include with the pipe lines.

The Public Service Commission defended its position on the following basis: The company had successfully demonstrated to the court that, because of pumpage, its water tax was an equitable one. The city was prepared to sell water at nearly half the company rate and still make a profit. Los Angeles now had an abundance of water from the aqueduct, and the citizens of the Hollywood district were entitled to the enjoyment of municipal service. The only question, then, was whether an entirely new system should be built or the company's pipe lines purchased, improved and extended. Adoption of the first plan, from estimates already prepared, would cost $1,500,000; but a rate war would follow, many miles of improved streets would be torn up, and there would result a large economic waste that the water consumer would in the end have to pay.

The board recognized that the company had been a pioneer and had helped to build up the district. On this account the board was willing to take over and pay for, in adequate amount, any works that would prove of use, despite the fact that purchase meant heavy expenditures and replacements, because poor service endured from the company would not be brooked from the city.

Board Puts Limit on What It Will Pay For

The board at this time (Aug. 14, 1914) refused the purchase of any lands, reservoirs, rights-of-way or pumping equipment as not needful for its purposes. The company had procured extensions almost exclusively by requiring tract owners into whose property mains were extended to pay the cost thereof and give a bill of sale. These extensions the company had successfully capitalized before the courts as a part of its investment. (A recent California law makes this no longer possible.) This judgment the Public Service Board did not attempt to go behind in its offer of $476,000. It did, however, decline to pay the amount of $103,983 for street paving, because it was found almost without exception that the company had laid its mains before any extensive paving was undertaken in the district. Whether it would cost the city $103,983 for paving if a new system were built, the board maintained, did not enter into the question before the company and the city.

The board also refused to pay for any services or any meters. This refusal was on the ground that every consumer had been required to pay outright for the service and for the meter. Whether or not he could show a receipt was immaterial. The charges of the company were of record for these items. The company showed where it was required to maintain services and meters in perpetuity. The board, however, from a record of its own costs on these items, showed that the high prices charged by the company for meter and service installation, if the company had so handled its funds, would pay the cost and leave a surplus, the interest on which would take care of all repairs and renewals in perpetuity. Under these circumstances the board, acting as the trustees of the water consumers of the district, refused to make them pay for things which they had already once purchased. Liability insurance was disallowed without discussion.

No Allowance for Going Value

The item of $60,000 for good will and going value also was disallowed. From the protests of consumers it was evident that good will was a negligible item of appraisal, as not being in existence. Going value was considered. It was felt that going value represented the desirability of the security in which the investment was made. The inclusion of this item in the appraisal was fair, provided the company enjoyed the assurance of continued operation under normal conditions. The board firmly intended, however, to build a new system if an agreement with the company could not be entered into. The company could not hope to compete for long with the city's gravity system; and the going value, if any existed under the conditions, was entirely dependent upon whether the city would agree to take over such parts of the system as it could find use for. To pay any part of the $60,000 was to pay for something which the city itself was absolutely creating, and the item was therefore cut out of the appraisal.

The company felt safe in declining the proposal, for the board had no money at its disposal to make the purchase and to commence the immediate building of a new system. The company, therefore, after refusing to negotiate further, began a broadside newspaper-advertising campaign to force the board to place the whole matter of settlement before the State Board of Railroad Commissioners on the basis of the board's own engineering valuation of the property, hoping thereby to secure payment at least for meters and services and probably, also, severance damage. Delegations of business men, acting in good faith, but anxious for a settlement, by representatives and petition urged the board to this end.

Not Moved by State Railroad Commission

No commission of the state bears a higher respect for its probity and efficiency than the Railroad Commission, but the Public Service Board refused to be moved by all the pressure that was imposed. The board members disclaimed any hostility whatsoever against the company or its officials. They maintained that they had been appointed to manage the water properties and service of the city; they proposed, so long as they were in office, to manage that business in the same manner that they would conduct it as a private corporation with themselves as stockholders and directors. They had offered for the property what they considered it actually worth to the city, and they declined to be moved by manufactured public opinion.

In January, 1915, at the session of the state legislature the city procured the passage of the so-called Benedict Act, a measure which provides for the formation of an improvement district within a municipality. The procedure and methods of forming the district are the same as for the formation of an irrigation district in unincorporated territory. The board refused to make any further water sales to the company, and on July 5, after several strenuous days, officials of the corporation capitulated. The pipe-line system, outside as well as inside the city,

a water-works yard, miscellaneous equipment, a year's improvements and a quantity of newly purchased cast-iron pipe brought the purchase price up to a grand total of $579,080.

With no money to pay for the works and pending the time at which a bond election could be held, the board at once took a lease and 18 months' option to purchase, paying $25,000 out of the water revenues as an initial payment and $20,000 per month to apply on the principal and deferred interest. The rates of the company were then continued in effect, and the investment about carries itself from sales of water.

In August, as soon as the Benedict Act became operative, the board, in coöperation with improvement associations of the locality, procured the formation of the district and carried to a successful issue the voting of a $1,020,000 bond issue by a vote of 4,299 to 408, or at the ratio of 10 to 1.

As soon as the bonds can be issued and sold, the rates will be reduced to those effective on the old city system. Of the amount voted, $510,000 will be applied to that part of the Union Hollywood system within the district, the remainder will be expended in enlarging and extending laterals and the construction of three large trunk lines, two of which will act as feeders to provide an adequate flow from the aqueduct system. On that part of the system not included within the district the old company rates will be maintained until the lines pay for themselves, requiring, it is estimated, about three years.

Engineering Co-operation

By C. E. Drayer*

One thing that stands out clearly in a study of the world's progress in recent years is the tendency to bring together scattered and highly specialized activities into organizations where effort is coördinated to the end that the product of the whole shall be of greater and improved quality with a benefit accruing to both producers and consumers. Whether the product is of the hand or of the brain, this statement holds true.

That engineers are somewhat behind other groups of men in the general movement toward coöperation is probably due to the youth of the profession. The period of selfish specialization, from which we are emerging, is one of normal development preceding the days of greater fruition when we begin to study the wider interests of ourselves and of mankind about us. At first the individual engineer worked in isolation, mentally if not physically. Then came the desire to mingle with his fellows, and the engineering society was born. Today there is a current, obvious to all, setting in the direction of an organization in which the collective efforts of engineers will be administered for the good of the profession and the public. Let us recite a few developments, some quite recent, illustrating this organized effort.

In the Northwest there is in process of formation the Minnesota Joint Engineering Board, whose avowed aim is to secure effective coöperation among engineers for the good of the profession, to correlate the work of engineering organizations for unity of action, to improve standards of practice and to bring about a clearer recognition of the engineer as a civic asset. The chairman of the organization (E. T. Street) is chairman of the Minnesota Branch of the American Institute of Electrical Engineers, and the secretary (Geo. W. Rathjens) is last past-president of the Civil Engineers Society of St. Paul. One of the present activities of the Minnesota engineers is an effort to have an engineer appointed to the Board of Regents of the State University.

While the writer is not informed as to the full scope of the Minnesota board, it appears to be an excellent arrangement for correlating the interests of the local, state and national engineering societies within the borders of the state. The logical correlation of the efforts of state organizations remains to be worked out, perhaps by the national societies, when the one with the spirit of progress undertakes the leadership.

Engineers in other states are making organized effort to secure the appointment of engineers on public-service commissions. Engineers of Spokane, Wash., wrote to the governor of Idaho, asking him to consider the selection of an Idaho engineer to fill a vacancy on the State Public Service Commission. Pennsylvania engineering societies requested the governor, on more than one occasion, to appoint an engineer on the Public Service Commission. If the first efforts of this sort are not successful, it remains for the engineer through long and hard work to teach the public by word and deed that the engineer is an honest and efficient public servant, capable of taking administrative control. The ear of the politician is ever turned to the voice of numbers.

Beginning in 1909, the Engineers Society of Pennsylvania has held at Harrisburg five state conferences and exhibits to promote engineering coöperation, industrial and public welfare, safety and industrial efficiency. These conferences have been excellent means of educating the public and have been so satisfactory to all concerned that state departments have sought to take them over, presumably because they were successful undertakings. This same society was instrumental in promoting the act authorizing the appointment of an engineering commission to take evidence and report with recommendations in reference to a licensing law. The report of the committee, made to the governor, has just been made public. (See *Engineering News*, Mar. 9, 1916, p. 484.)

Licensing by states, or other suitable regulation of engineering practice, is demanded in many quarters by engineers as well as by the public. This subject requires broad and unselfish consideration. It is well for us to take cognizance of what the doctors, lawyers and architects have done, and it is pertinent to say that each class must work out its own salvation according to the elements of the problem of which it alone is best able to judge. Two reasons come to mind why action should be prompt. On the one hand, due to the organized activities of architects, laws have been passed in some states which make the engineer an employee of the architect. Control is completely in the hands of architects, because the state board of examiners is composed of architects. Had the engineers of Illinois, for instance, been organized to combat this pernicious legislation before it became law, they would have spared themselves humiliation and labor. On the other hand, there is a movement among engineers in at least two places to standardize wages. These conditions were theories a few years ago; today they are facts. Perhaps a recommendation by the national societies for standard practice in licensing would find favor.

*Secretary, Committee on Engineering Coöperation, 1801 East 93d St., Cleveland, Ohio.

Within comparatively recent years there have sprung up in our larger cities local engineering societies which have met a real demand, as is evidenced by their rapid growth and continued success. They furnish that companionship which must be found at home and which the national societies cannot give, even by the formation of local sections of their own members. In any community there should be a local society containing all the engineers residing there. The fancied opposition of interest of local and national societies is based on a lack of comprehensive understanding and is absurd. Local sections there should be, within the local society. Strong national and strong local societies should be mutually helpful.

We must not lose sight of the fact that individual progress and growth are promoted by close acquaintance and that it is broadening to a man to attend meetings, hear papers and take part in discussions outside of his restricted specialty. It is increasing the worth of the individual until he is capable of leadership that will put the engineering profession to the front.

Particularly in the smaller political divisions, like counties or cities, there is need of concerted action. The appearance before the local public of a united group of technical men capable of giving intelligent opinion on public questions would enable engineers to exert influence for good on local government. This work cannot be effectively done, if at all, from the headquarters of a national society; but there should be a national organization to promote efficient management of the local society and to furnish stimulation and continuity of action.

Definite progress in coöperation has been made between engineers themselves and between engineers and the public in Buffalo, St. Paul, Philadelphia, St. Louis, Cleveland, Detroit, Pittsburgh, Nashville, Chicago and other places. The Civil Engineers Society of St. Paul secured the appointment of an engineer on the St. Paul charter commission, to whom has been assigned the chairmanship of the committee to draft provisions in the charter covering engineering activities of the city. He is also a member of the committee on civil-service rules. A committee of the Buffalo Engineering Society advises with the newly elected city commissioners. In Philadelphia a Development Committe has been named to formulate and solve problems arising from the recent acquisition of a large number of members. The experiences of this and other societies should be made available in concise form for the guidance of sister organizations throughout the country. Local societies of Pittsburgh, Detroit, Buffalo and Cleveland have visited each other during the past three years, promoting an acquaintance which is of value to all. The Cleveland society plans to publish later in the year a booklet, not so much for the information of the engineer as to explain to the intelligent layman what the work of the engineer is. Other societies will be asked to coöperate in the publication and marketing of this experimental magazine.

Committee on Engineering Coöperation

About a year ago, almost simultaneously, two organizations were formed having a similar purpose, but differing in their methods of bringing it about. The American Association of Engineers was organized to raise the standard of ethics of the engineering profession and to promote the economic and social welfare of engineers. Emphasis is laid on the commercial phases of engineering. The Committee on Engineering Coöperation is composed of volunteer members who seek to bring about coöperation through existing organizations:[1] When a society is found capable and willing to carry on the work of this committee, its self-imposed duties will be lightly transferred and the existence of the committee will have been justified.

An invitation has been issued by this committee to all engineering organizations to send delegates to a conference on engineering coöperation, to be held Apr. 13 and 14 in the rooms of the Western Society of Engineers, Monadnock Block, Chicago, The following items among others may be considered:

1. Coöperation among engineering organizations. Is it desirable? In what way is it practicable?
2. Benefits of coöperation in securing greater efficiency in the larger matters of concern to the individual engineer, to the profession and to the public.
3. Methods of coöperation now in practice in various localities; results attained in Philadelphia, St. Louis, St. Paul and other places.
4. Various kinds of engineering societies and committees and the relative efficiency of their operations.
5. Relation of the specialized or exclusive national engineering societies to their local sections or branches and to the more inclusive local engineering society or club.
6. Result of coöperation in securing wider diffusion of knowledge on engineering subjects, as illustrated at Cleveland and elsewhere.
7. The engineering profession as a whole in its present condition as regards public esteem.
8. Reasons for decline in attendance at engineering colleges. Is it indicative of heathful conditions or of proper methods of education?
9. Employment; methods and results as practiced by various engineering societies; an exchange of ideas.
10. Legislative activity, proper limits to be set, dangers to be avoided and needs of more systematic and better-directed efforts.

It is desired that a representative body of engineers attend this meeting and be prepared to take part in the discussion. If it is impossible to send delegates, it is hoped that as many as possible will give the matter of procedure and organization careful thought and give the committee the benefit through written discussion.

Leakage from Water-Works Pipe Joints is being investigated by a committee of the New England Water-Works Association, of which F. A. Barbour, Tremont Building, Boston, Mass., is chairman. In a circular letter addressed by the committee to possible suppliers of information it is stated that much water and consequently much money are wasted through leakage from street mains. The committee then proceeds to ask these questions: "What is the best shape of joint? The best material? Are we using sufficient care and the best methods in making joints? What should be the specified or attempted tightness in new work? Does leakage through the joints now generally employed—even if originally small—increase after the pipe has been laid some time, and if so, can a joint to prevent this be developed?" To answer these very pertinent questions the committee has prepared an inquiry blank that it has sent to the members of the association. Information will also gladly be received from any water-works man, whether a member of the association named or not. To that end, blanks will be supplied on receipt of requests addressed simply to Secretary, New England Water-Works Association, Tremont Temple, Boston, Mass.

[1]The membership of the committee is: F. H. Newell, chairman, University of Illinois, Urbana, Ill.; C. E. Drayer, secretary, Cleveland, Ohio (secretary, Cleveland Engineering Society); Willard Beahan, Cleveland, Ohio (past-president, Cleveland Engineering Society); H. H. Esselstyn, Detroit, Mich. (past-president, Detroit Engineering Society); Farley Gannett, Harrisburg, Penn. (past-president, Engineers Society of Pennsylvania); Charles R. Gow, West Roxbury, Mass. (civil engineer and contractor); George H. Herrold, St. Paul, Minn. (president, Civil Engineers Society of St. Paul); A. J. Himes, Cleveland, Ohio (past-president, Cleveland Engineering Society); John C. Hoyt, Washington, D. C. (president, Washington Engineering Society); A. Stucki, Pittsburgh, Penn. (past-president, Engineers Society of Western Pennsylvania); D. Robert Yarnall, Philadelphia, Penn. (vice-president, Engineers Club of Philadelphia); John Younger, Buffalo, N. Y. (president, Engineers Society of Buffalo).

Cylinder-Pier Foundations of the Lincoln Memorial*

By James A. O'Connor†

SYNOPSIS—Details of layout and construction of deep pier footings under Lincoln Memorial on what was the old Potomac flats at Washington, D. C. Unique and difficult cylinder-pier work. Operations are under direction of Office of Public Buildings and Grounds, with Col. W. W. Harts, Corps of Engineers, U. S. A., in charge.

The Lincoln Memorial at Washington is situated at one end of what might be called the main axis, or base line, of the grand development running west from the Capitol and which is fixed by the Capitol building, the Washington Monument and the Lincoln Memorial. Their centers are on a straight line running practically through the center of the present West Potomac Park. When L'Enfant's plan was developed, the section of the present park west of the Washington Monument was an expanse of tidal mud flats. Within the past 30 years this marshy area has been filled in by material dredged from the Potomac River. During the discussions preceding the appropriation of the necessary funds for the memorial and the approval of the design, great stress was laid upon the lack of a practicable foundation, especially a foundation suitable for the massive monumental structure which was deemed necessary to fit in with the general proposed plan of the capital city and to represent by its dignity, grandeur and loftiness of purpose the character of Lincoln.

The problem was to provide a stable foundation for a structure 204 ft. long by 134 ft. wide, with a total weight at the original grade level of approximately 50,000 tons distributed among 106 piers.

To understand more clearly the foundation problem, a brief description of the structure will be given. It consists of a memorial hall, 84 ft. wide and 156 ft. long, surrounded by a colonnade of 36 massive columns representing the 36 states at the time of Lincoln's death. The height of the building itself is about 83 ft., and the memorial hall is divided into three sections by two rows of interior columns 50 ft. in height. The central and main section is to contain the main feature, a statue of Lincoln of heroic size, and the side sections are to contain memorial tablets of his Gettysburg speech and of his second inaugural address. The base of the building is 45 ft. above the original grade level and will be reached by means of terraces. The building is of white marble, obtained from the Colorado-Yule quarries at Marble, Colo.

Details of Two Parts of Foundations

The foundations are, for convenience, divided into two parts—the upper foundations, including the part above the original grade level (El. 16); and the subfoundations, extending from the original grade level down to rock.

The upper foundations consist of 106 rectangular concrete piers, which vary in size from 3x6 ft. to 7 ft. 4 in. by 11 ft. and are 45 ft. high. The 3x6-ft. piers are reinforced, and the 46 piers supporting the superstructure columns are hollow, with walls 2 ft. thick. Connecting the exterior piers are reinforced-concrete walls 1 ft. thick. The piers support the beams, arches and the main floor. The concrete was a 1:2:4 gravel mixture, with the exception of the solid nonreinforced piers, which were of a 1:3:6 mixture.

The subfoundation, which is described in more detail later, consists of reinforced-concrete piers supporting the upper foundation piers and extending down to, and 2 ft. into, bedrock.

The ground is as shown in Fig. 1. The upper 16 ft. is a loamy sand, which showed no settlement under a test load of 4 tons per sq.ft. Below this layer, extending down to rock, is what was generally considered to be mud. Actually, except for the top 2 ft., which had been turned to mud by the ordinary vegetable growth in a tidal flat, the material is a kind of blue clay, which showed no settlement with a load of 1 ton per sq.ft. The bedrock, which is a gneiss, is, as shown, an average of 49 ft. below the original ground level. The bedrock is covered by a 2-ft. layer of disintegrated rock.

Twenty wet test borings were made; these showed the clay layer to be comparatively soft and of doubtful value

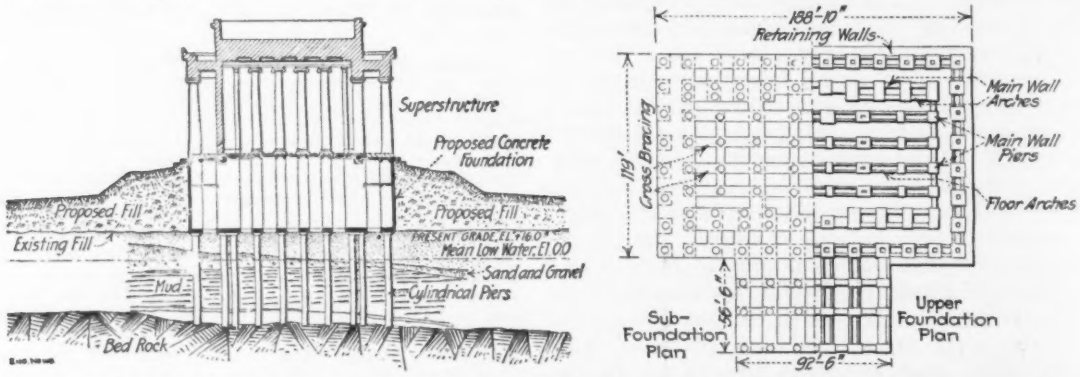


FIG. 1. VERTICAL AND HORIZONTAL SECTIONS THROUGH LINCOLN MEMORIAL, SHOWING DETAILS OF FOUNDATIONS

*From "Professional Memoirs, Corps of Engineers, United States Army and Engineer Department at Large," March-Apr. 1, 1916.

†Captain, Corps of Engineers, U. S. A., Washington, D. C.

as a suitable foundation. Moreover, foundations on a similar material in this locality had not proved altogether satisfactory. Rock of a more stable character was within reach, and there was but small disposition on the part of those responsible for the construction of the building, or on the part of Congress, to do any experimenting with a $2,000,000 monumental structure. Spread foundations to horizontal thrust was required; hence it was decided that the foundation piers should be considered as columns and should be of sufficient cross-section, or be properly reinforced, to resist horizontal pressure.

On the foregoing basis, piles could not be considered. The original plans showed large rectangular plain concrete piers extending into the rock. In the bids, however,

FIG. 2. VIEW OF LINCOLN MEMORIAL FOUNDATIONS IN COURSE OF CONSTRUCTION

Cylinders forming the subfoundations are shown in the process of sinking, and piers forming the intermediate foundations between the subfoundations and the building proper are also illustrated. The connecting grillage is shown in the background of the view; the reinforcement of the cylinders is shown in the middle foreground; the method of sinking by placing weights on the cylinders, assisted by water jet on the outside, is shown at the right and left sides, and the concrete piers of the intermediate foundations are shown in the distance

might prove satisfactory, but rock foundations certainly would and were adopted.

As a result of the investigation the following conditions for a suitable foundation were decided upon:

1. That the foundation should consist of piers extending to and bearing on the underlying rock.

2. As the safe resisting pressure of the rotten rock was an unknown quantity and was undoubtedly less than that of good concrete and since the safe rock pressure should be at least equal to that of the concrete in the piers, the second requirement was that the foundation piers should extend through the rotten rock and bear on the firm rock.

3. Since, due to the uncertain nature of the wet-clay layer, it was expected that the fill of about 1,000,000 yd. around the building might result in horizontal pressures, as a provision for resistance against sliding, it was required that the foundation piers should extend into the firm rock at least 2 ft.

4. As the unsupported length of the foundation piers varies from 42 to 53 ft., provision against bending due

alternate plans were proposed at a considerably reduced cost. In these plans steel cylinders were to be sunk to rock, the interiors excavated and filled with reinforced concrete. One plan provided for grouping 2-ft. cylindrical piers under the main piers and another for using large cylindrical piers, averaging 4 ft. in diameter, excepting for the largest main piers, where two for each pier were to be used.

The latter plan was submitted by M. F. Comer & Co., of Toledo, Ohio, with the lower bid of $215,000 and was accepted. The highest bid for the rectangular piers was $442,000 and the lowest $278,000. The accepted subfoundation plan in detail is as follows:

It consists of 122 reinforced-concrete circular piers, which extend 2 ft. into the solid rock at the bottom and which are tied together with a crossbracing at their tops at the original ground level. The diameter of these piers varies from 3 ft. 6 in. to 4 ft. 2 in., and they are reinforced with twelve 1¼-in. square twisted steel rods, with the exception of the piers 3 ft. 6 in. in diameter, which are reinforced with twelve 1-in. rods. The forms for

the subfoundation piers were steel cylinders, ½ in. thick for the lower 20 ft. and ⅜ in. thick for the remainder. The cylinders were sunk to rock, the earth and rock were excavated, the reinforcing steel was placed, and the cylinders were then filled with concrete. The crossbracing at the original ground level is concrete 1 ft. thick, reinforced with ¾-in. square twisted steel rods placed 12 in. on centers, top and bottom. This crossbracing at the top of the subfoundation piers, together with the 2-ft. penetration of each pier into the rock, at the bottom, makes a unit of the subfoundations.

[The investigations made into the stability of the foundations included investigation of the safety of the cylinder

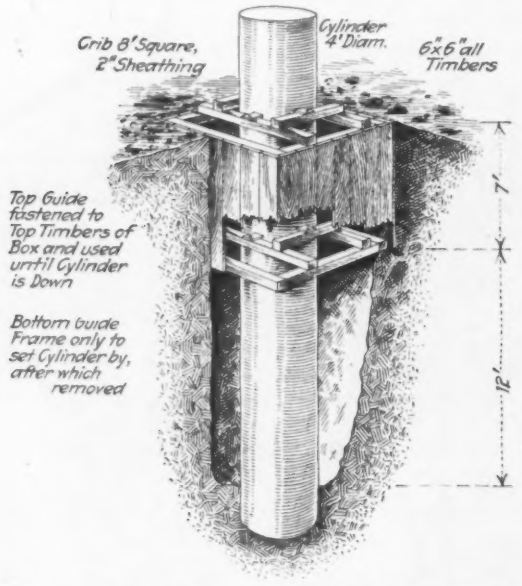

Crib 8' Square, 2" Sheathing
Cylinder 4' Diam.
6"x6" all Timbers
Top Guide fastened to Top Timbers of Box and used until Cylinder is Down
Bottom Guide Frame only to set Cylinder by, after which removed
7'
12'

FIG. 3. DETAILS OF CRIB IN WHICH CYLINDERS WERE SUNK

piers against crushing due to the total load, which showed that the total stress was about 500 lb. per sq.in. on a concrete that should be good for over 2,000 lb. per sq.in., an investigation of the lateral resistance of the piers acting as unsupported columns. The thrusts for which the piers were figured in lateral resistance were those due to the hydraulic pressure of the tidal range in the near-by river, which was considered to be transmitted through the earth-fill, and the weight of the fill exerting side thrust on the underlying ground and through that to the piers. It was found that the piers, acting as reinforced-concrete columns in bending, together with the resistance of the steel casing, were sufficient to withstand the side pressure, especially as the thrust was assumed to be transmitted from one pier to another through crossbracing.—Editor.]

Construction of the Subfoundations

From the deductions from the information obtained from the borings it was fully expected that it would be necessary to use air in working below the water level. The wet clay, however, was decidedly water-tight, and the only trouble was from water that came through the porous top sand layer. The equipment included a complete air-compressor plant with two 60-hp. locomotive-type boilers, an air compressor and an air lock. For setting the cylinders and handling the material there were two 10-ton stiff-leg skid derricks. The original plan was to excavate from the inside of the cylinders with a 2-ft. orange-peel bucket. The material was too stiff to make this plan successful, and the excavation had to be made with short-handled shovels, the material being lifted out in large buckets, for the handling of which two small derricks were later added to the equipment.

The general plan was first to make the initial excavation, then to set the cylinder and to sink them with the large derricks and to follow up with the small derricks for the excavation from the interior of the cylinders.

The method used in sinking a cylinder was first to sink an 8x8-ft. box or crib (Fig. 3) through the sand until the lower edge was resting in the clay. The crib was placed in position and sunk with an orange-peel bucket. Next, a hole was dug into the clay about 12 ft. deep. Guides were placed on the top and bottom timbers of the box and the first section of the cylinder, 27 ft. long, was placed. The weight of the cylinder section was sufficient to sink it into the clay and firmly fix it in position. It was then loaded, usually with five 2½-ton concrete blocks, which sank it until its top was level with the top of the box. The interior was then excavated by hand to 2 or 3 ft. below the cutting edge, when the second section, 13 ft. long, was placed in position and bolted. To sink this section required 20 tons of weight and jetting with a 2-in. jet around the outside of the cylinder. The inside was again excavated below the cutting edge and the third section added to the cylinder. This settlement generally required a load of about 30 tons and in some cases jetting for the full length of the cylinder around the outside. After the removal of the disintegrated rock, about 2 ft. thick, the final settlement of the cylinder to

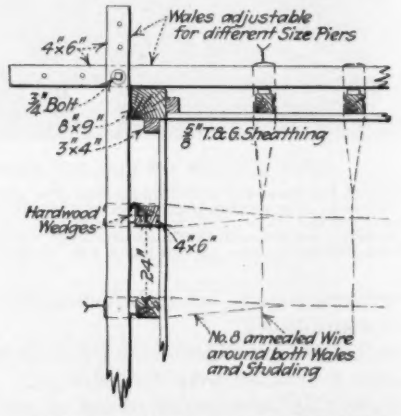


FIG. 4. CORNER SECTION OF FORMS FOR UPPER FOUNDATION PIERS, LINCOLN MEMORIAL

solid rock again required a load of about 30 tons and considerable jetting.

The jetting was the principal cause of the trouble with the water. It opened up a passage for water to seep down from the top along the exterior surface of the cylinder, and considerable quantities had to be removed before the final placing of the concrete. The next step was the excavation of the rock to a depth of 2 ft., which was done by blasting. The reinforcement was then placed in position.

The reinforcement was assembled on the ground and consisted of twelve 1¼- or 1-in. steel bars averaging 52 ft. long, spaced and tied to a $\frac{7}{16}$-in. spiral-rod hoop rein-

forcing and placed by the derrick. The hoop reinforcement, with the fastenings, was not sufficiently rigid to prevent the assembled reinforcement from collapsing, and a method was developed in which the rods were bolted to three steel rings with a 1x6-in. section, one at each end and one in the center. These rings were left on the assembled units until the reinforcement was finally placed and wedged in the cylinders.

The concrete, a 1:2:4 gravel mixture, was placed in the cylinders with a bottom-dump bucket holding ½ cu.yd., which was lowered by a small derrick and tripped after the previous batch had been tamped with the loaded bucket.

The water was removed by bailing with buckets holding about 12 cu.ft. This method was found to be more rapid and economical than the steam siphon, which was used only to handle the water at moderate depths. The water was the cause of a great deal of trouble, and it is probable that it could have been much more easily handled with some one of the various kinds of portable water pumps.

Though the use of the skid derrick (see Fig. 2) is usual on work of this character, its selection in place of the derricks on wheels in this case was occasionally criticized. The principal factor in the handling of the job was the careful selection of capable foremen. The ease with which they could shift the heavy derricks, compared with the difficulties of some of the inexperienced foremen, was very instructive; and considering the trouble to be expected in taking care of the tracks and broken wheels, there is little doubt as to the correctness of the contractor's judgment in preferring the skid derricks.

The costs in the subfoundations varied considerably, due to the varying weather and other conditions, but a few average costs are given. The average cost of sinking and excavating a cylinder ready for reinforcement was as follows:

Overhead	$37.50
Plant equipment	99.50
Supervision and labor	207.50
Average cost of cylinder	188.00
Total	$532.50

Assembling and placing steel reinforcement averaged $13.45 per cylinder.

The total cost of the concrete in place per cubic yard, excepting the concrete materials but including overhead, plant and equipment supervision and labor, was $1.78 per cubic yard. The concrete materials cost $3.35 per cubic yard. Common labor was 20c. per hour.

Construction of the Upper Foundations

The construction of the upper foundations was similar to massive concrete work of the same character. The only unusual point was due to the fact that it was specified that certain piers be poured to a height of 37 ft. at one time.

The forms developed were adjustable to the various sizes of the piers and withstood the pressure with very little deflection. A corner section is as shown in Fig. 4. The waling pieces were spaced 2 ft. 6 in. on centers vertically, and the corner posts were made up in one 12-ft., two 10-ft. and one 5-ft. sections for convenience in handling and adjustment to the various heights. When the forms were removed, the top 5-ft. section was left in place to carry the beam and the floor forms.

Some of the 3-ft. 6-in. piers were poured in an hour and a half; and the only bulging was in places where it could be traced to the fact that, after the tie wires had been twisted up, they had been partially untwisted before the pouring of the concrete, to get the specified distance between the form walls. Once the untwisting of the wires was started, the pressure due to the concrete was sufficient to cause a considerably increased untwisting.

Some of the average costs are as follows: The total cost of building and stripping the forms for the piers and retaining walls was $0.11 per square foot; and for the beam, arches and floors, $0.22 per square foot.

The foundation is now complete and the superstructure being erected.

Chicago Street Widening

Two important and costly projects for street widening at Chicago are now going through the preliminary stages. They are for the widening of Michigan Ave. and of 12th St., and both are parts of improvements included in the "Chicago Plan," as reviewed in *Engineering News*, Mar. 11, 1915. Both projects include expensive bridges of interesting designs. The work is in charge of the Board of Local Improvements, of which C. D. Hill is chief engineer. John Ericson is city engineer.

The widening and improvement of Michigan Ave. is to extend north from Randolph St. to the Chicago River, in connection with a new bridge over the river and a new street to connect this with the boulevard system north of the river. The main part of Michigan Ave. is a fine broad boulevard, but for the three blocks north from Randolph St. it is a 66-ft. thoroughfare forming a "bottle-neck" that carries the very heavy traffic between the boulevard and the Rush St. bridge. The Michigan Ave. bridge will be a double-deck bascule structure with inclined viaduct approaches. The upper deck will be for automobiles and pleasure traffic, and the lower deck (without sidewalks) will be for the heavy team traffic of the river-front streets.

The court proceedings for this improvement have been commenced. It will take probably the remainder of the year to secure a confirmation by the lower court and final approval by the Supreme Court of Illinois. Thus it is not likely that bids for any of the work can be received before 1917.

The 12th St. project provides for widening, improving and converting the street into a boulevard, all the way from Halsted St. east to the lake front (at Grant Park), a distance of over 2 mi. The present width is about 66 ft. This change will involve a long viaduct over the railways, and the Chicago River will be crossed by a 244-ft. drawbridge of the balanced-lever or direct-lift type. At present this street ends at Michigan Ave., beyond which it is blocked by railway property. The present railway station and terminal are to be abandoned, however, and rebuilt south of the extension of the 12th St. boulevard leading to the lake front.

The proceedings in the lower court are nearly concluded. It is considered most probable, however, that an appeal will be taken to the Supreme Court, which will prevent any work being started before October, 1916. This relates only to the work as far as Michigan Ave., the extension being a separate project.

Field and Office

Handling Pipes and Conduits in Sewer Trenching

The handling of water mains and the various utility pipes and conduits encountered in the excavation of sewer trenches is provided for very definitely in the new sewer specifications issued by the Board of Local Improvements, Chicago. These apply only to sewers built by special assessment. C. D. Hill is Chief Engineer of the Board; George C. D. Lenth is Assistant Chief Engineer of Sewers. The provisions, somewhat condensed, are:

The alteration of any utility or water main in the space to be occupied by sewers will be done without expense to the contractor.

Where excavating machines of the steam-shovel type are used for sewers 3 ft. in diameter or larger, any utility crossing the trench and any water main less than 16 in. in diameter will be removed and replaced without expense to the contractor; 16-in. and larger mains are to be left in place and supported at his expense.

Where excavating machines of the endless-belt type are used, all water mains will be maintained at the expense of the contractor. Where such machines are used for sewers less than 24 in. in diameter, he will also maintain all utilities; but for sewers of 24 in. in diameter and larger the utilities will be removed and replaced without expense to him.

Where sewer trenches are excavated in rock, each utility company will take care of its structures and the Bureau of Engineering will take care of water mains, provided that five days' notice is given before blasting is done and that special care is taken by the contractor.

Where the distance between centers of a new sewer and a parallel utility is not greater than the internal diameter of the sewer plus 4 ft. (or the external diameter plus 4 ft. for water mains), the utility (or main) will be maintained or removed without expense to the contractor. Where a water main is at a greater distance, the contractor will be liable for damage done to it. If the parallel utility is outside the lines of the trench and is left in place, the contractor, if directed, must leave sheeting or bracing in place, for which he will be paid.

Where excavating machinery is not used (except in rock), all utilities crossing the trench will be left in place and maintained at the expense of the contractor.

Where utilities or water mains cross a sewer trench and it is inadvisable to remove them, the contractor will be paid the additional cost of excavation under and around them by hand, in accordance with the following rule: In estimating the cubic feet of excavation the length of the section will be taken as equal to the length of the sewer trench occupied by the utilities plus 1½ times the depth of the trench (no deduction being made for space between adjacent utilities); the width of trench will be the internal diameter of the sewer plus 3 ft.; the depth will be the distance from the surface of the ground to 6 in. below the inside of the bottom of the sewer. The contractor will be paid a uniform rate varying with the extreme depth of the excavation from 2c. per cu.ft. for a depth of 6 ft. to 7c. per cu.ft. for a depth of 24 ft.

This rule applies in the case of excavating machines of the endless-belt type, which are used for the construction of sewers 24 in. in diameter or larger. Where sewers 3 ft. and larger in internal diameter are constructed by means of excavating machines of the steam-shovel type, $5 per lineal foot of trench is added.

Where sewers are constructed in paved streets and it is necessary to remove, alter or repair any utility or water main without expense to the contractor, the replacement of the pavement disturbed on account of such alterations outside of the limits of the sewer trench will be done without expense to him. For this purpose the width of the trench will be determined by adding to the internal diameter of the sewer an amount depending upon the thickness of the walls of the sewer. This amount will be 3 ft. for sewers 3 in. thick or less, 4 ft. for thickness up to 6 in., 5 ft. up to 10 in., 6 ft. up to 16 in. and 7 ft. for all sewers exceeding 16 in. in thickness.

Where excavating machinery is used, all service lines from utilities to buildings will be removed without expense to the contractor (if 48-hr. notice is given). All utility aërial equipment interfering with the operation of such machinery will also be removed; but if it interferes only with backfilling machinery, it will not be removed (except at his expense).

In regard to water service pipes, the contractor must ascertain for himself their existence and location. Where they are removed, cut or damaged in the construction of the sewer, the contractor must at his expense at once cause them to be replaced or repaired. In no case is he to receive extra compensation (in any form) for the removal, maintenance, lengthening, repairing or replacing or extra labor involved on account of water-service pipes encountered. He must not shut off the water-service pipe from any consumer for a period exceeding 6 hr.

Whenever street-railway tracks in the street in which the sewer is to be constructed are moved, the contractor must provide proper planking and approaches for the passage of traffic across the street ahead of the excavation. At cross-streets he must (when directed by the engineer) provide bridges or other means of crossing.

⁂

Cutting Through House Services in Street Trenching—In machine trenching for sewer work in Houston, Tex., the inevitable destruction of house services that cross the line of the trench is made the sole responsibility of the contractor under a clause in the city's specifications covering such work. The city engineer must issue a written order before the contractor is permitted to injure any sewer, water or other pipe. This regulation is disregarded in practice, and the contractor goes ahead after simply notifying the property owners. In replacing these pipes a reinforced construction is used in order to avoid damage from settlement. The pipe put in to replace the damaged section is surrounded by an open wooden box of a width twice the outside diameter of the pipe and of a depth three times that diameter. The box extends 2 to 6 ft. back from the side of the trench and is filled with concrete after reinforcing bars are placed in the bottom. Thus a reinforced-concrete beam is formed around the pipe. The cost of this work is included in the cost bid per lineal foot of sewer.

Electric Maintenance Dredge on Kaw River

The small number of electric dredges in use in this country has recently been increased by an interesting craft purchased by Wyandotte County, Kansas (Kaw River Drainage Board, Kansas City), for cleaning up the Kaw River between levees for a section of 9 mi. from the river mouth. This is an important industrial district, and maintenance of a clear channel decreases flood troubles. Special interest attaches to this dredge, shown in the accompanying illustration, as one of the few receiving their power from shore by cable.

The dredge cost $62,000 and was designed and built by the Morris Machine Works, Baldwinsville, N. Y. The hull (90x32 ft. by 5 ft. 3 in.) is of wood, with steel trusses; there are two 24-in. wooden spuds. A 16-in. centrifugal pump is driven by a 750-hp. variable-speed induction motor, operated by a drum controller. The suction pipe is placed on a 36-ft. structural-steel ladder and has a steel agitator, or cutter head, driven by a 50-hp. motor. The drum hoist has a 25-hp. motor. There is also a 4-in. horizontally split general-service pump furnishing 400 gal. per min. against 140-ft. head. A 6-in. two-stage pump is driven by a 75-hp. motor to supply a

ELECTRIC SUCTION DREDGE FOR KAW RIVER

hydraulic giant on the bow of the dredge. A 2½-in. pump driven by a 2-hp. motor furnishes cooling water for the electrical equipment. Electric current is delivered along the bank by a 6,600-volt line; it is stepped down to 2,300 volts and led to the dredge by a submarine cable.

Block Street-Number System Completed in Utica

A block system of street numbers for the entire City of Utica, N. Y., was completed on Feb. 2, 1916, when the city council adopted the renumbering plans of the city engineer, Joseph Kemper, for the section of the city west of Genesee St. The city engineer's plans for the eastern section were adopted Feb. 4, 1914, after 17 years' agitation.

Many difficulties were encountered, owing to the irregular arrangement of streets, as shown in the accompanying sketch, and a few arbitrary steps were required in the heart of the city. So-called "rectifying ordinates" were established, beyond which the normal conditions prevailed (these are indicated by *R* in the sketch). Some little dissatisfaction was found with the radical change at first, but the benefits of the plan quickly won recog-

NEW STREET NUMBER PLAN, UTICA

nition. It was immediately adopted by the electric, gas, water and express utilities and by the post office, and taken up with favor by most of the people.

The new numbers were furnished property owners free and were attached by the city renumbering forces. Nickeled brass figures costing 3½ to 4c. each were used. A number of people were disinclined to permit their dwellings to be renumbered (and they could not be compelled), until advised that all the utility services would use the new system and that it was to the advantage of householders to do the same.

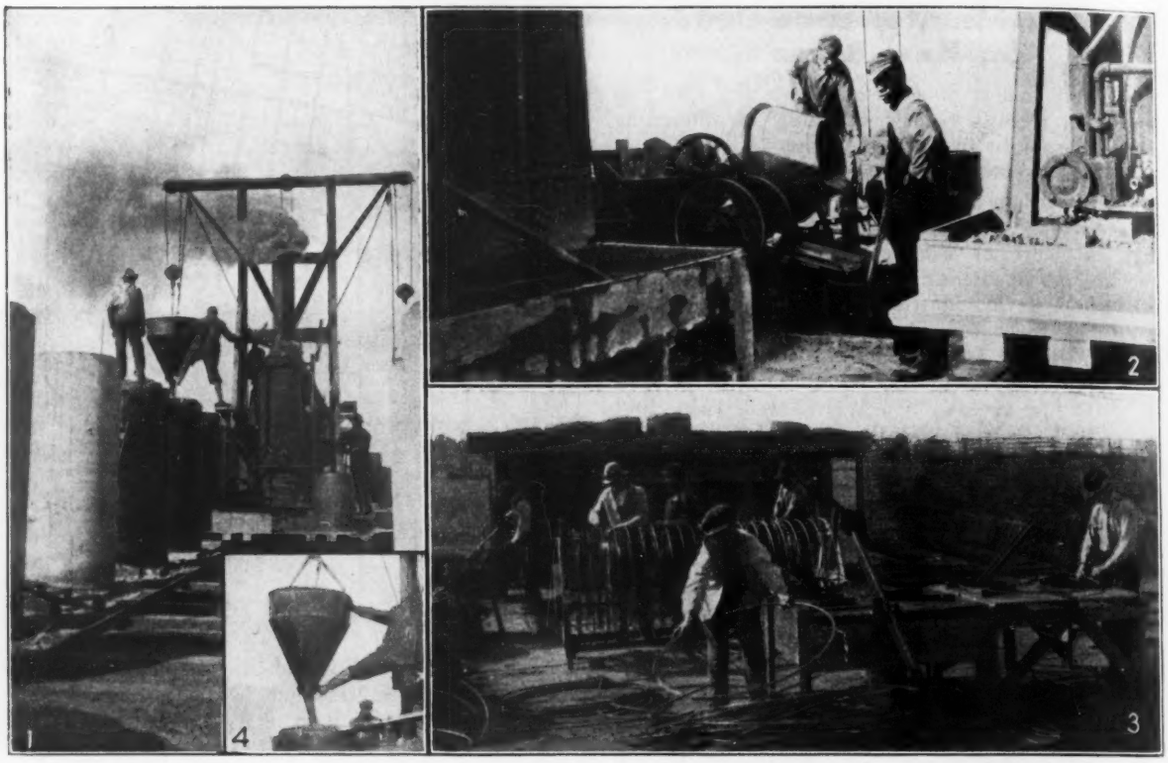
The old city directory showed for every street all the numbers and residents thereon between intersecting streets. Sets of these lists were pasted on cards and the new numbers added also. This has proved of immense service in referring from new to old numbers for given premises.

Making Lock-Joint Concrete Pipe at Dallas, Tex.

About 4 mi. of the force main from the pumping station of the Dallas, Tex., sewage disposal works to the Imhoff tanks is to be of concrete pipe 4 in. thick and 36 in. in diameter. This pipe line has been guaranteed by the makers, the Lock Joint Pipe Co., New York City, to have a leakage of less than 22,000 gal. in 24 hr. under a pressure of 30 lb. per sq.in. The pipe is cast in 8-ft. lengths and has patented lock joints according to the Meriwether system.

The manufacturing plant for this pipe is laid out in a level field some distance from the Trinity River, about halfway between the two ends of the main. Through the middle of the yard is a traveling crane, or T-frame, mounted on a 6-ft. gage car and track. Square concrete bases for the steel pipe-forms to rest on are planted in the ground on each side of the track, about 6 ft. apart.

At one end of the yard are two "Little Wonder" concrete mixers (gasoline-engine driven) of ⅛-cu.yd. capacity each, one on each side of the crane track. Fig. 2



FIGS. 1 TO 4. PLANT FOR MAKING LOCK-JOINT CONCRETE PIPE FOR SEWER FORCE MAIN, DALLAS, TEX.
Fig. 1—Traveling crane and bucket. Fig. 2—Concrete mixer and grout-mixing box. Fig. 3—Making hoop reinforcing units Fig. 4—Special bottom-dumping bucket

shows one of these mixers and its position with respect to the crane. In the left foreground of Fig. 2 is the mixing box for the 1:1 grout used in the bells of the pipe.

At the other end of the yard the reinforcement is fabricated. The straight bars, cut to proper length, are run through rolls and bent approximately to the correct radius. They are then passed to tables laid out with templets, where the bending to accurate dimensions and the wiring of the ends of the hoops together are done. The hoops are then passed along to the reel-like structure shown in Fig. 3, where they are formed into pipe units. They are correctly spaced by dropping into four accurately notched longitudinal bars.

All Work Controlled by Templets

In making up the reinforcement and in all the other pipe-making operations, everything is done to templet. The superintendent has so arranged the procedure that no workman needs, or is even allowed to have, a foot rule. The final operation in making the reinforcement units is performed by a workman after the bars are taken off the reel. It consists in making one or two wire loops halfway up the hooped cylinder, to keep it from collapsing longitudinally when placed in an upright position.

The copper for the joints comes in sheets. It has to be run through three hand-operated crimping rolls, to give it the U-shape crimp for an expansion joint. The plate is then punched at intervals by hand, to furnish a bonding surface for the concrete. The copper plates are bent around a wooden templet and soldered to the correct radius. The wire-fabric hoop reinforcement for the bells of the pipe is similarly shaped and soldered to the correct radius.

The process of pouring the pipe is as follows: The bell end of the pipe is down, and two pails of 1:1 grout are first poured to make the bell. On top of the inside

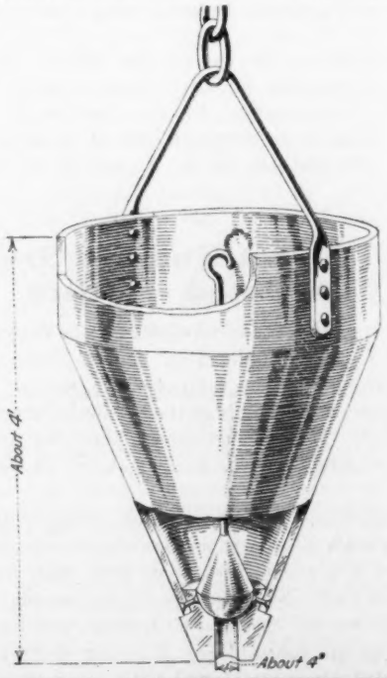


FIG. 5. DETAIL OF BOTTOM-DUMPING BUCKET, LOCK JOINT PIPE CO.

shell is a round steel plate that serves the double purpose of holding the shells in proper alignment and of forming the dumping platform for the concrete. Obviously, a bottom-dumping bucket is required. The one shown in the illustrations Figs. 1 and 4 is an entirely new one, first used on this work. It was invented and is patented by J. C. Mitchell, Lock Joint Pipe Co., who is superintending the manufacture of this pipe.

The principle of the bucket is shown in the sketch, Fig. 5. The shell is of riveted sheet steel, cone-shaped, with a cylindrical top. Its capacity is about ⅜ cu.yd. The patented feature is the valve and dumping device. As anyone knows who has worked with concrete, it is very difficult to empty half a cubic yard of concrete through a 4-in. hole in the bottom of a bucket, on account of the arching of the material over the opening. The bucket shown accomplishes this purpose and also controls the flow of the concrete, so that as much or as little as desired may be dumped or the flow cut off.

How the Special Pouring Bucket Works

The bucket is filled with the valve and stem in place. The upper half of the valve, or plug, is cone-shaped, and the lower half is hemispherical and fits snugly into a hollow hemispherical casting. A hand-operated lift line is attached to the valve stem, and by lifting, the flow of concrete is started and controlled. Any tendency of the material to arch over the opening is prevented by a slight tightening and slacking on the lift line. The concrete runs out over the top plate of the form and over its edges into the shell in a steady, uniform flow. As soon as a bucket is emptied, a man with a long-handled wooden paddle tamps the concrete in the forms. At the mixers the buckets are placed in pits while being filled.

When the concrete has sufficiently set, a steel sling is fastened around the middle of the sections of the pipe, and they are picked up and laid on their sides on wooden runways, about 50 ft. long, extending at right angles to the crane track on either side. The sections of pipe are rolled to the far ends of these runways, where they remain to finish curing. The ends of the runways are sufficiently elevated so that the sections of pipe may be rolled from them directly upon special wagon bodies provided for haulage to different parts of the work.

Underground Sewage-Pumping Station, Abilene, Kan.

What appears to be an ornamental traffic signal and lamp post is shown in the accompanying illustration, Fig. 1. It is the motor housing of an automatic sewage-pumping station in Abilene, Kan. The conditions are shown in the profile, Fig. 2. Originally the motor and pump were located in the manhole, but the damp atmosphere and the fact that the creek had a habit of occasionally rising just enough to flood the manhole, putting the apparatus out of business at the times it was most needed, led to another solution of the problem.

The motor is now housed in a sheet-metal structure, shown in Fig. 1, which is 30 in. wide at the base and about 8 ft. high, built on a concrete base on one side of the manhole. The motor is about 8 in. above the street level. It is a 5-hp., 3-phase, 220-volt motor with vertical shaft, driving a 120-gal. per min. centrifugal pump (2-in. suction) at 800 r.p.m. It starts automatically when the sewage is 8 ft. above the bottom of the manhole and stops automatically before the suction pipe is uncovered. It runs about 4 hr. per day. The motor and pump cost $260 and the house and lamp $75.

FIG. 1. SEWAGE-PUMPING STATION AND TRAFFIC SIGNAL POST

The pumping station is located at a street intersection, and the projecting motor housing was therefore made into a traffic signal. There is a white light on top, and red bull's-eye lights face traffic in each direction. Kenyon Riddle, City Manager, is the designer.

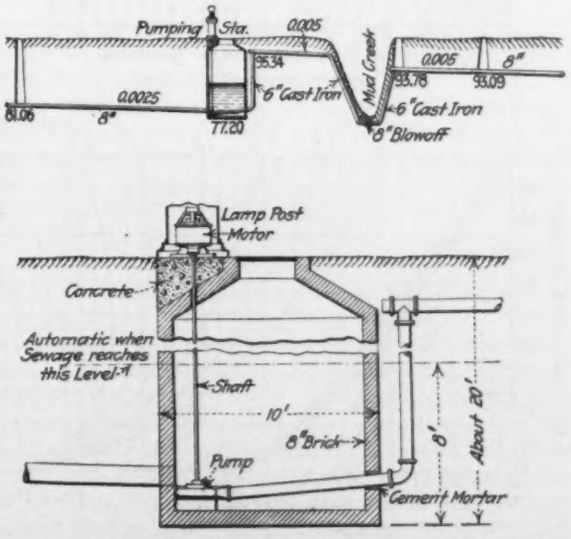


FIG. 2. LOCATION SKETCH AND DETAIL SECTION OF SEWAGE-PUMPING STATION

Design Charts for Open Flumes with Catenary Section

By Ernest L. Robinson*

When a suspended flume is to be designed for pure tension, the hydrostatic catenary must be used. This is an unusual curve. Its mathematical properties are well known (tension constant throughout its length; radius of curvature inversely proportional to depth of water); but computations cannot be made by ordinary methods, because the equation of the curve can be written only in terms of the elliptic integrals. On this account it has been customary to make designs by graphic analyses based on the known properties of the curve. To avoid these methods, the charts below have been plotted from the equation of the curve, using tables of elliptic integrals.

*Westinghouse Church Kerr & Co., New York.

Figs. 1 to 4 are for use when the curve extends to the water surface—that is, when the curve is complete. The superposition of these charts shows several interesting facts.

For any particular area of flume section, (1) the tension in the sheet is a minimum when the width is 1.20 of the depth; (2) the wetted perimeter is a minimum and the mean hydraulic radius a maximum when the width is 1.92 of the depth; and (3) taking the amount of material in the sheet as proportional to the product of the tension and the wetted perimeter, this quantity will be found to be a minimum when the width is 1.47 of the depth.

The carrying capacity of an open flume is proportional, according to the Chezy formula, to the product of the area and the square root of the mean hydraulic radius. For any particular carrying capacity the amount of material in the sheet will be found to be a minimum when

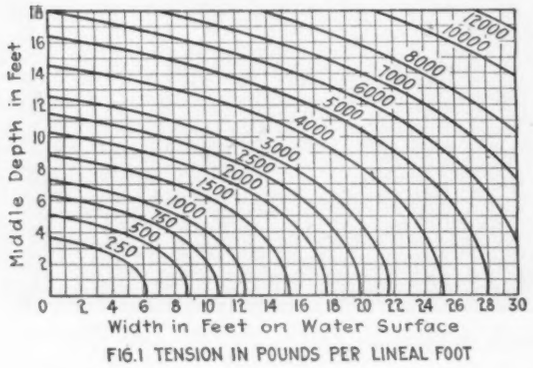


FIG.1 TENSION IN POUNDS PER LINEAL FOOT

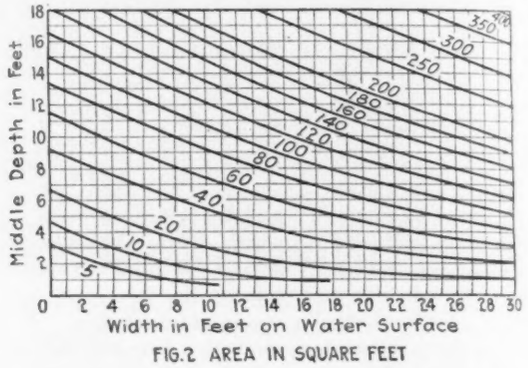


FIG.2 AREA IN SQUARE FEET

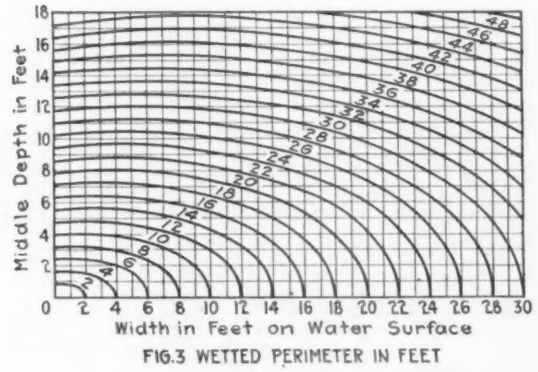


FIG.3 WETTED PERIMETER IN FEET

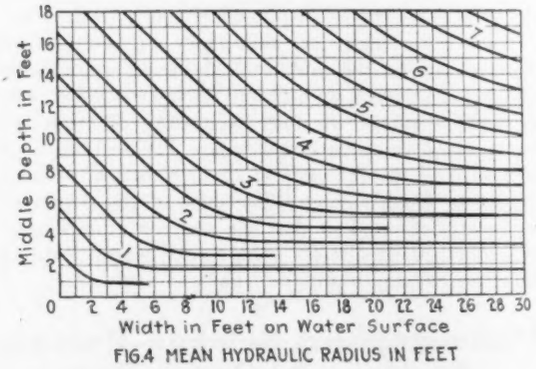


FIG.4 MEAN HYDRAULIC RADIUS IN FEET

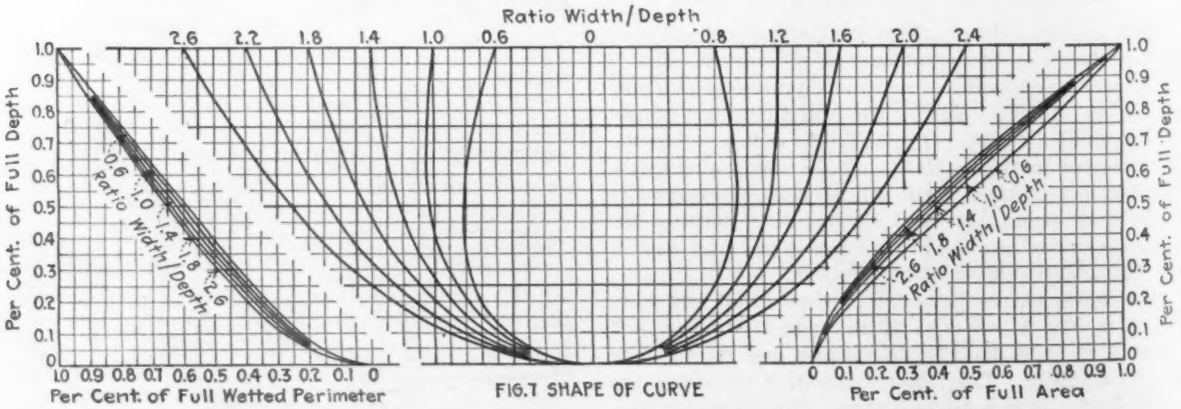

Ratio Width/Depth
2.6 2.2 1.8 1.4 1.0 0.6 0 0.8 1.2 1.6 2.0 2.4
Per Cent. of Full Depth
0.6 1.0 1.4 1.8 2.6 Ratio Width/Depth
1.0 0.6 1.4 1.8 2.6 Ratio Width/Depth
Per Cent. of Full Wetted Perimeter
Per Cent. of Full Area

FIG.5 FIG.7 SHAPE OF CURVE FIG.6

CURVES FOR DESIGNING HYDRAULIC-CATENARY FLUMES—E. L. ROBINSON

the width is 1.55 of the depth. A design may be called economical when the ratio of width to depth lies anywhere between 1.3 and 1.9. Between these limits the amount of material corresponding to a given capacity does not vary more than 3%.

Fig. 7 shows the actual shape of the hydrostatic catenary for various proportions of width and depth. Figs. 5 and 6 are for use when the curve does not extend to the water surface and is therefore incomplete. In this case the properties of the section can be computed as illustrated herewith. Suppose a rectangular flume 16 ft. wide and 3 ft. deep has a catenary bottom 7 ft. deep below the rectangular part, making a total depth of 10 ft. First, it is necessary to find of what complete catenary this bottom curve is a part. At 0.7 of the full depth of the water the width of the flume is 1.6 of the full depth. Looking at Fig. 7 and measuring 0.7 up from the bottom and then half of 1.6, or 0.8, on each side of the center line, it is found that the curve marked 1.8 exactly meets this prescribed condition.

Hence, were the curve complete, its width at the water surface would be 18 ft. Fig. 1 gives the tension as 4,300 lb. per lin.ft. Fig. 2 gives the area of the complete curve as 134 sq.ft., and Fig. 3 gives the wetted perimeter as 29.4 ft. For 0.7 depth, Fig. 5 gives a wetted perimeter of

$$0.79 \times 29.4 = 23.2 \text{ ft.},$$

and Fig. 6 gives an area of

$$0.61 \times 134 = 82 \text{ sq.ft.}$$

Including the rectangular section, the total area of the flume is 130 sq.ft. and the mean hydraulic radius 4.45 ft.

The equation of the hydrostatic catenary is mathematically the same as that given for the elastic curve of a deflecting column on p. 1109 of *Engineering News* for June 10, 1915. Similarly the formula for true length of a deflecting column gives the wetted perimeter of the catenary. The diagrams of the elliptic integrals there printed are equally useful for solving the formulas on which Figs. 1 to 7 of the present article are based.

Cost of Hauling Gravel by Team and by Tractor*

By O. L. Kipp†

The information here given is derived from the gravel checkers' records on five team-haul jobs totaling 22 mi. of road graveled and one tractor-haul job covering 3.6 mi. of road graveled. The gravel was placed at the rate of 15 cu.yd. per 100-ft. station.

On the team jobs 1½-yd. loads were hauled uniformly. The team wagons were loaded by hand, with a maximum of two shovelers. The accompanying table gives the records and shows also how the hauling cost could be lowered if the time of loading were reduced to 12 min. and 6 min. per load. The figures warrant these conclusions, for in job. No. 2, on the ½- to 1-mi. haul, the cost was 22.9c. with 8.7% loss of time at the pit; on the 1- to 1½-mi. haul the cost was 29.4c., as compared with 29.8c. estimated. On the 1½- to 2-mi. haul of job No. 3 the cost was 38.4c., as compared with the estimated 38.5c.; and on a 2.95-mi. haul the cost was 67c. with a 12.3% loss of time, as compared with the estimated cost of 65c.

Efficiency in team hauling and consequent low cost are largely dependent upon, and might easily be secured by, obtaining the maximum efficiency in loading. This problem is by no means as easy as that of the hauling, for many varying conditions are encountered. The total loading and hauling cost on the various jobs was figured to provide for the shovelers actually employed and $5 per day additional for the general superintendence of a foreman or the contractor.

The loading costs vary from 7 to 25c. per yd., the lower figures being too low on account of the teamsters acting as shovelers while waiting to get into the pit and the highest figures being boosted on account of an excessive amount of frost and firewater and also poor supervision. The lowest job average for loading was 9c. per yd., due largely to favorable pit conditions. For average Redwood County pits 10 to 15c. per cu.yd. should cover loading by hand. Whether or not some mechanical loader would be able to reduce this item, I am unable to state.

The failure to solve successfully this mechanical-loading problem contributed in a large measure toward increasing the figures for gravel hauling by tractor. The outfit consisted of a Holt caterpillar gasoline tractor with seven Troy 3½-yd. reversible spreader wagons, a 50-yd. storage bin and a belt-conveyor loader.

When the first train was loaded, it was found that the tractor would not pull more than two cars over a short sharp pitch at the railway crossing on the most direct route. Experiment showed that four cars could be hauled across fields to the top of a short pitch about ¾ mi. from the pit and that, by doubling back for the remaining three cars, a train of five cars could be made up and drawn the remaining distance of 2¼ mi. About 1,365 cu.yd. was handled in this way over an average distance of 3 mi., or a total of 4,125 cu.yd.-mi. at the average rate of 129 cu.yd. per mi. per day. With $20 per day to cover operation, interest and depreciation, the rate was 15.4c. per cu.yd. per mi. for the hauling.

From the next pit was taken 1,584 yd. to a distance of 1 to 3.6 mi., making a total of 3.422 cu.yd.-mi. There were no grades over 2%, and with an average of 142 cu.yd.-mi. per day the cost was 14.1c. per cu.yd.-mi. On several days the total was 216 cu.yd.-mi., which would be at the rate of 9.2c.

The advantage in favor of the tractor would have been greater with a more powerful machine. The capacity of the train was reduced also by the insufficient capacity of the loading equipment. With power to pull six cars and with a trainload of gravel always ready when the train arrived at the pit the record of 9.2c. per cu.yd. per mi. could have been maintained throughout the job. But the outfit cannot make money while waiting to be loaded.

A bin of 25 to 30 cu.yd. capacity must be provided and must be easily transported from pit to pit. This portable feature is essential for the loading apparatus also. In this case the cost of taking down, moving and reërecting the bin amounted to fully 10c. per yd. of gravel handled. The belt conveyor may be successful on a level grade or on a slight incline, but raising the gravel about 30 ft. vertically was beyond its practical range. The cost of loading with this apparatus was 25 to 30c. per yd., which with the cost of moving the bin makes a total

*Abstract of a paper read at the annual meeting of the Minnesota Surveyors and Engineers Society, St. Paul, Minn., Feb. 10-12.

†District Engineer, State Highway Commission, Redwood Falls, Minn.

COST OF HAULING GRAVEL WITH TEAMS*

Haul	0–¼ Mi.			¼–1 Mi.			1–1¼ Mi.					1¼–2 Mi.				2-2½ Mi.	2½-3 Mi.	2.65 Mi.
Job No.	1	2	5	1	2	5	1	2	3	4	5	1	3	4	5	3	3	1
Total loads hauled	407	475	482	327	1,571	364	606	525	898	44	746	312	873	434	198	337	267	714
Average No. teams hauling	7.2	5.2	4.5	9.6	7.0	9.0	6.5	7.6	7.0	6.0	8.7	6.4	7.5	5.2	4.6	8.0	7.2	18.7
Average loads per team-day	12.1	14.0	9.45	9.75	11.67	7.35	7.0	9.1	7.55	7.33	6.0	5.4	6.93	6.73	5.35	4.6	4.0	3.9
Load miles per team-day	4.24	4.62	2.83	7.31	8.75	5.51	8.75	11.38	9.44	9.16	7.50	9.45	12.13	11.78	9.36	10.35	11.0	11.51
Per cent. time dumping (5 min. per load)	10.0	10.9	7.8	8.1	9.7	6.1	5.8	7.6	6.3	6.1	5.0	4.5	5.8	5.6	4.4	3.8	3.3	3.2
Average time in pit per load	30.6	25.0	46.0	26.6	16.5	46.7	39.7	11.0	24.4	24.5	45.0	36.0	11.5	14.2	37.2	36.0	35.1	30.9
Per cent. time in pit per load	61.7	58.3	73.3	43.2	32.0	57.2	35.9	16.7	30.7	32.9	45.0	32.5	13.3	15.9	33.2	27.2	23.4	20.1
Per cent. time required for loading at 12-min. per load	24.2	28.0	18.9	19.5	23.3	14.7	14.0	18.2	15.1	14.7	12.0	10.8	13.9	13.5	10.7	9.2	8.0	7.8
Per cent. time actually lost in pit	37.5	30.3	54.4	23.7	8.7	42.5	21.9	.....	15.6	18.2	33.0	21.7	.....	2.4	22.5	18.0	15.4	12.3
Average No. teams at pit	4.5	3.0	3.3	4.1	2.2	5.1	2.3	1.3	2.2	2.0	3.9	2.0	1.0	0.8	1.5	2.2	1.7	3.8
Hauling cost per cu.yd., cents	21.9	19.0	28.3	27.3	22.9	36.3	38.1	29.4	35.3	36.4	44.4	49.4	38.4	40.0	50.0	58.0	66.7	67.0
Load. and hauling per cu.yd., cents	29.9	28.0	38.3	34.3	30.9	46.3	49.1	39.4	47.3	51.4	56.4	66.4	51.4	60.0	75.0	76.0	89.7	76.0
Contract price per cu.yd., cents	45.0	39.0	35.0	60.0	50.0	45.0	70.0	65.0	65.0	60.0	65.0	85.0	80.0	75.0	80.0	107.5	122.5	109.0
Spreading cost per cu.yd., cents	2.0	2.25	3.75	1.75	2.00	2.50	3.75	2.50	3.0	3.75	3.0	5.0	3.25	5.0	6.25	4.5	5.75	2.25
Hauling per cu.yd.-mi., cents	73.0	57.6	94.3	36.4	30.5	48.4	30.5	23.5	28.2	29.1	35.5	28.2	22.0	22.8	28.5	25.8	24.3	22.7
Hauling per cu.yd.-mi. with 12-min. for loading, cents	43.0	43.0	43.0	27.8	27.8	27.8	23.8	23.5	23.8	23.8	23.8	22.0	22.0	22.0	22.0	21.2	20.6	21.2
Hauling per cu.yd.-mi., with 6 min. for loading, cents	.....	.....	34.1	24.5	.....	.....	21.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hauling per cu.yd., with 12 min. for loading, cents	.....	13.5	.....	.....	20.5	.....	29.8	.....	.....	.....	.....	.....	38.5	.....	.....	.....	.....	.....

* The figures in this table are based on 25c. per hr. for man alone and 40c. per hr. for man and team.

loading cost of 35 to 40c. per yd. With proper equipment this should not exceed 10c. per yd.

There are other features in favor of tractor hauling. By applying the gravel in two courses with a tractor the gravel is rolled without additional cost, and the road is ready for travel as soon as the gravel is applied instead of a month or more later, as with teams. By loading into a bin, thence to wagons and thence to the road, an efficient mixing of the materials is obtained instead of having one load with good gravel with a fair amount of binder followed by a load of sand with no binder.

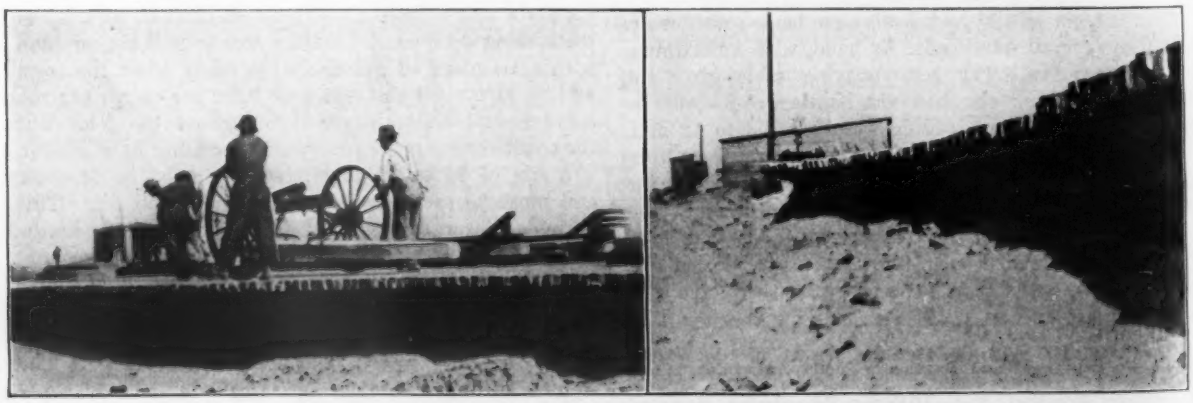
NOTES

Full-Tempered Hand Punches Are Dangerous—A warning to users of hand punches is sounded by C. D. Melhuish, Jamestown, N. Y., of the insurance firm of Slone, Melhuish & Co. He says: "In investigating reports of accidents we find many hand punches in use in which the temper is the same throughout the entire length of the tool, which makes it extremely dangerous to the operator because of its liability to chip. Would you care to call the attention of both the manufacturers and buyers of these tools to the advisability of annealing the hammer end of the tool?"

An Ocular Demonstration of what a well-grouted brick pavement will stand, without any foundation whatsoever, is shown in the accompanying illustrations. These pictures show a part of the washed-out sections of the boulevard that follows the famous Galveston (Tex.) sea wall. The damage was done in the great storm of last summer. The pavement is of repressed brick with grouted joints and, except for the two portions where the water and waves got behind and under the pavement, is in almost perfect condition today, notwithstanding the fact that the bricks are laid on the sand without a foundation of concrete or macadam. The cantilever slab shown in Fig. 1 projects fully 5 ft. at its widest point without support. The picture shows a two-wheel truck loaded with a reinforced-concrete sheet-pile, which must have weighed nearly 1,000 lb., passing over this cantilever. In fact, this part of the pavement appears to have been chosen to cast concrete piles. Fig. 2 gives some idea of the length of the cantilever.

Filling for an Earth Dam at Paris, Ill., was done by dumping wagon loads far apart instead of close together. The loads were about 12 ft. apart in rows 5 ft. apart along the line of the dam. All teams dumping within 150 or 200 ft. of the end farthest from the borrow pit traveled to the end of the row before turning. Other teams turned as soon as their wagons were dumped. The loads were leveled and spread with a grader. This method of work was described in a paper presented by George C. Habermeyer before the Illinois Society of Engineers. He thought few contractors would object to dumping the loads far apart after they have tried it, as a better driveway is secured and the grader is not likely to be very busy.

Old Concrete Found Good—Concrete in the New York subway, placed 10 to 15 years ago, has proved to be in very good shape in those locations where reconstruction work has made it necessary to cut into it, according to a paper by Robert Ridgway, Engineer of Subway Construction, read before the American Concrete Institute in Chicago. Some of the reconstruction work involved the cutting out of the original concrete in many places. Mr. Ridgway says that it is a satisfaction to state that there has been no evidence of any disintegration of the old concrete from electrolysis or other causes. Two pieces of concrete from the lining of the Park Ave. tunnel were cut out within the past few months, shaped into a 6x6x12-in. prism and tested for compression. One sample failed at 3,950 lb. per sq.in.; the other did not fail at the capacity of the machine, about 4,000 lb. per sq.in. This concrete was 13 years old, and the samples were selected as being rather below the average quality of the concrete being removed in the vicinity. In driving the shields for the tunnel which passes under the East River from Old Slip, Manhattan, to Clark St., Brooklyn, the Manhattan shields encountered the concrete foundation of the bulkhead wall that was constructed in 1905. This foundation was in the form of concrete deposited in salt water in burlap bags and was found to be in excellent condition. The burlap of the bags was intact in places, and the general appearance of the material was that of mass concrete placed in the dry.



FIGS. 1 AND 2. BRICK PAVEMENT WITHOUT FOUNDATION, GALVESTON, TEX.

Editorials

Why Indiana's Public Service Commission is Popular

Pleased with the reduction of local water-meter rates by the Indiana Public Service Commission, the Terre Haute *Tribune* reviews savings in public-utility charges in the state, which have been brought about since the commission came into full swing. The *Tribune* figures out a saving of $500,000 a year by a net annual expenditure of $73,000 thus:

> Among the amounts directly saved to the consumers, as shown by the records and as pointed out by Judge Duncan, were these: Indianapolis, gas, $125,000 a year; Indianapolis, light and heat, $233,000; South Bend and Elkhart, light, $45,700; Terre Haute, water, $30,000; Evansville, gas, $25,000; La Fayette, light, $12,000; Richmond, water, $10,000; New Albany, light, $12,000. The most important reductions in all cases have been to small users.

The commission is credited with other savings, not the least of which have been human lives. The rulings of the commission are claimed to have been fair to the companies, so that new capital is being invested in public utilities in Indiana. Moreover, the commission is declared to be absolutely nonpartisan. No wonder it is popular. Other commissions will please copy—in so far as they are not already in the same category.

Water-Power Legislation in Congress

A very large body of engineers, contractors and manufacturers are deeply interested in the question whether Congress will at the present session pass legislation that will make capital willing to invest in enterprises for water development. It is stated on the best of authority that work on water-power developments amounting to a million horsepower will go forward immediately if Congress enacts satisfactory water-power legislation at the present session. It is probable that several times that amount will be undertaken within the next few years, in the event of such legislation.

The Ferris bill, which passed the House Jan. 8, provides for 50-yr. leases by the Federal Government of rights to develop water power in which use of the public lands is involved. The Shields bill, which passed the Senate Mar. 8, provides for leases of the same length of time of the right to develop water power on navigable streams. Each bill provides for control by the Federal authorities, to the end that the work may be carried out on proper engineering lines and with a view to a broad development and full protection to all other interests concerned in the use of the water. Each bill further provides that the rates, etc., charged for power developed shall be subject to regulation by proper state authorities, or by the Interstate Commerce Commission where the power is transmitted across state boundaries.

Of course, the final form that each of the bills may take is still to be determined in its passage through the other house and probably in final discussion in conference committee; but it is very greatly to be desired in the public interest, not less than in the interest of the many thousands whose employment and business are at stake, that each of these bills shall become law at the present session of Congress and shall be enacted in such form that capital may again be attracted to water-power investments.

From the point of view of true conservation, whenever power can be generated by falling water instead of by burning coal or oil, we are saving stored-up mineral fuel that once burned, can never be replaced. This is not a problem of the remote future, but of the present. The demand for kerosene, gasoline and other products of petroleum is again increasing faster than the supply. Under steam boilers millions of gallons of oil are being burned that in all probability will be sorely needed, a very short time hence, as a fuel for motor trucks and other vehicles.

The conservation movement, however, has been to a large extent diverted from this original and most important end and made to stand for opposition to the giving away by the Federal Government of valuable privileges. The importance and value of this movement also are not to be denied. The policy of giving away the title to public lands, mines, forests, water-power sites and other valuable gifts of nature to the first person who chose to grab them was a policy that had to be abandoned.

In its place there is substantial agreement that these gifts of nature should be exploited under conditions that will protect the rights of the public while at the same time safeguarding the rights of those who invest their money in the development of these natural resources.

The opposition to the water-power bills in Congress appears to be due chiefly to those who, through lack of knowledge of the conditions under which water power is developed, believe that every water-power site is a profit-yielding gold mine and that, when the Government leases to some party or company the right to develop a water power, it should receive a substantial rental.

In the bills previously referred to some return is, indeed, provided for. The party developing water power by a dam on a navigable stream, for example, must build at its own expense canals and locks for the use of boats. If it uses surplus water at a dam built by the Government, it is to pay for it at a rate to be fixed by the Secretary of War.

If it is attempted, however, to incorporate in the bills provision for a large rental or heavy tax for a power site, the development of power under the bills will be strictly limited. It must not be overlooked that for the development of a profitable water-power business there are necessary, not only an available site, the legal authority to use it and improve it and other real estate for transportation lines, rights-of-way, etc., but in addition a large amount of engineering and business ability. And this last is just as necessary as the first. For the lack of this last, a great number of water-power enterprises scattered

all over the country have yielded a loss instead of a profit to those who invested in them.

The conditions under which water-power development is to be made possible must include not merely a return on the capital invested at current interest rates and a return in addition sufficient to compensate for the risk attendant on every water-power enterprise, but also a profit sufficient to attract the business and engineering ability requisite to obtain the best results possible.

If the pending bills go through in such form as closely to limit the possibilities of profit, the result will be the development of only a few enterprises, where conditions are exceptionally favorable and risks are small. If, on the other hand, the legislators so frame the bills as to give a reasonably free hand to water-power enterprise, work will certainly go forward on a large scale. There is no room for doubt that the latter result rather than the former is to be sought in the public interest.

Deceiving the American Society of Civil Engineers

An idea is being disseminated among members of the American Society of Civil Engineers remote from New York City to the effect that the proposed removal of the society's New York City headquarters from its present house to the Engineering Societies' Building is a change that really means the merger or affiliation of the society with the other national societies. That such an idea is wholly groundless was explained in an editorial discussing the pending proposition in our issue of Feb. 17. We are now able to present in exact terms the charge which has been made and which we are informed has been sent to every local organization of members of the American Society of Civil Engineers outside of New York City. The charge is *verbatim* as follows:

> An invitation has been extended to the American Society of Civil Engineers to enter "the United Engineering Society as an additional founder society." This invitation itself shows that the destinies of the "founder societies" is largely if not wholly controlled by a superior authority; and the fact must not be overlooked that the relationship which exists between the United Engineering Society and the founder society which gives the former authority over them has not been presented in detail to our members.
>
> Suppose we become an "additional founder society" and desire to put before the public a measure which we have conceived and which we deem important. It must have the sanction of the United Engineering Society, representing a majority of the founder societies, which can prevent action, or, if approved, the United Engineering Society would stand before the public as the sponsor of the measure. This illustration applies equally to all of the founder societies.
>
> The sacrifice of independence and individuality most certainly would go beyond property ownership. We have gained an enviable and honorable position in public esteem without the aid of other societies, and membership in our society is accepted as a synonym for integrity, ability and efficiency. We have consistently conducted our affairs in such way as to prove that we are the champions of those virtues and have won our way as the leaders of movements looking to the uplift of the engineering profession.
>
> To turn over the laurels won during 64 years of consistent effort is indeed a sacrifice. It must be evident that, if the invitation to join the founder societies is accepted, we must surrender the prerogative of leadership which we have held so long and in the future be content to serve under the banner of the United Engineering Society.
>
> If we do accept the invitation, future national or other movements for the benefit of the profession will be headed by the United Engineering Society and our share in the work will be merely auxiliary thereto, the ultimate result of which will be that the influence and standing of the American Society of Civil Engineers, which are now conspicuous, will gradually wane and finally be lost in the controlling organization of which we will become a chapter.

If the charge just quoted were true, there is no question whatever that the proposition now before the members of the American Society of Civil Engineers would be and should be defeated. The society would not and should not sacrifice its independence of action nor give to any other organization authority over it in the conduct of its affairs.

There is not, however, the slightest foundation for the charge above made. Instead of its being true that the United Engineering Society has authority over the founder societies, the exact opposite is the case. The United Engineering Society is controlled by the founder societies. It is nothing more or less than a board of trustees appointed by and responsible to the several founder societies. It is the duty of this board of trustees to manage the building and its appurtenances in the interest of its owners. The offer of this board of trustees to the American Society of Civil Engineers was made by special authority from the governing boards of the founder societies. The board of trustees which constitutes the United Engineering Society is made up of representatives elected by the several societies, and these trustees change from time to time as their terms of office expire.

Properly speaking, the United Engineering Society is not a society at all, as that term is commonly used. It has no members, and is merely an incorporated board of trustees, elected by the national societies, whose property it holds and manages in trust.

How little ground there is for the foregoing charge may be seen by the fact that the three national societies of mechanical, mining, and electrical engineers have now been owning and occupying the Engineering Societies' Building for 12 years. The governing board of each of these societies has been carrying on its work in its own way all these years just as independently and as free from dictation from the United Engineering Society or any other outside source as has the Board of Direction of the American Society of Civil Engineers during the same time. Such a proposition as the control of any of these societies by the board of trustees called the United Engineering Society has never been heard of and would not be attempted under any circumstances, for no authority for such control exists.

The contrast between the foregoing charge and the truth is evident to everyone. It passes comprehension why any member of the American Society of Civil Engineers should make himself responsible for such a sweeping perversion of the facts as that previously quoted on a question of such importance and interest to the society. Such misstatement is all the more inexcusable, because the engineer who made it was a member of the committee of the Board of Direction which investigated the proposition for removal of the headquarters and joined with the other members of the committee in signing the letter sent to every member, commending the proposal to the membership.

Concerning this statement, there are only two suppositions: One is that the statement was sent abroad with the deliberate intention to deceive the membership as to the facts in the case. It is not believable that the engineer who has circulated this statement would be guilty of such an act. The other and only reasonable supposition is that the engineer who has issued this statement has done so through misinformation and misunder-

standing and failure to investigate the facts in the case. Under these circumstances it would seem that the only right and honorable action for the man responsible for this statement would be to acknowledge his error and attempt so far as possible to set right the members whom he may have misled.

There are in the circular letter from which the quotation is made a number of other statements that are almost equally misleading. Space permits at the present time reference to only one of them. We quote as follows:

> It is stated that there will be no material difference in the annual cost of operation [in the society's present house and in quarters in the Engineering Societies' Building]. This depends on the construction put upon the word "material." Expressed in actual figures, the writer finds the actual difference to be $2,511 in favor of our present home, based on an official figure.

How this computation was made does not appear. In view of what has been said already, the old maxim, "False in one, false in all," might be assumed to apply. For members of the society who wish to know the facts in the case, however, it may be of interest to compare a statement of the expenses incurred by the American Society of Civil Engineers in operating its present house at 57th St. with the expenses of the American Society of Mechanical Engineers in connection with its occupancy of the Engineering Societies' Building. The figures are taken in both cases from the official report of each society's governing board for the last year.

The report of the secretary of the American Society of Civil Engineers for the year ending Dec. 31, 1915, contains the following items that are chargeable to occupancy of the society's house: Caretaking, $1,861; house supplies, $136; maintenance of house, $3,033; heat, light and water, $1,304; total $6,334. The annual report of the Finance Committee of the American Society of Mechanical Engineers, rendered at the last annual meeting, shows an expense for the occupancy of the Engineering Societies' Building of $3,600.

It will be rightly judged by the members of the American Society of Civil Engineers, however, that differences of a few thousand dollars either way in the operating expenses of the society in connection with the proposed change are of trifling importance compared with anything affecting the welfare and prosperity of the society as a whole. The point on which greatest emphasis should be laid, we believe, is that in discussion of the pending question before the society the members are entitled to know the absolute facts in the case, free from all prejudice and preconceived ideas.

⁂

What Purpose Does a Code of Ethics Serve?

A committee of the Western Society of Engineers, made up of men eminent in the profession and of high character, has drafted a code of ethics which the society is to consider and adopt, if it approves. This code is entirely different from the codes that have been adopted by other engineering societies. Other codes consist for the most part of statements as to where an engineer's duty lies in certain specific situations that often recur in the profession. The code drafted by the Western Society of Engineers' committee, on the other hand, is an exposition of general principles that should govern any professional man in his conduct toward fellow-members of his profession, toward his clients and toward the public. It specifically avoids mention of specific cases and direction as to conduct therein.

No one, certainly, can criticize the lofty spirit that prevails in this code, nor can anyone question its value to the engineer who will seriously study it and accept its principles as a guide to conduct. The question is whether this is the sort of code of ethics that is the most useful for adoption by an engineering society. The answer to this question turns upon a clear understanding as to what purpose a code of ethics is to serve. To put the same problem in another way, Is it the purpose of a code of ethics to inspire those who join in its adoption to right living, high thinking and a high plane of moral conduct, or is it intended as a guide to correct conduct in specific cases where a man may honestly be puzzled as to where his duty lies?

Other engineering societies which have dealt with this problem have agreed that a code of ethics should be a set of statutes, as a definite guide as to what is correct conduct, with the incorporation in certain cases of some elementary moral principle such as the Golden Rule. It is true, as the Western Society committee points out, that no formulated code will cover all the ethical cases that may arise in the course of an engineer's professional practice. What such a code can do is to cover the cases which most frequently arise and on which opinions of engineers of inexperience are most apt to need guidance.

It is perfectly true that the majority of the members of a high-class engineering society, especially those of experience and standing, have little need of a code of ethics. They have learned by experience the proper rules of conduct in their professional relations, and they are no more likely to refer to a code of ethics as a guide to their behavior than they are to refer to the standard textbooks on elementary principles in engineering, which they studied when laying the foundation for their career.

The case is different, however, with the younger men who are gaining their experience. Even though they may be animated by such high principles as are set forth in the code proposed for the Western Society of Engineers, they are living in a practical world and not an ideal world; and they need to know what is accepted by the profession as sound ethical conduct when certain knotty questions arise. It is in the guidance of men of this class that the chief value of a code of ethics lies, and it is for this reason that a code made up of definite statutes seems to us more useful than a code that merely states general principles.

⁂

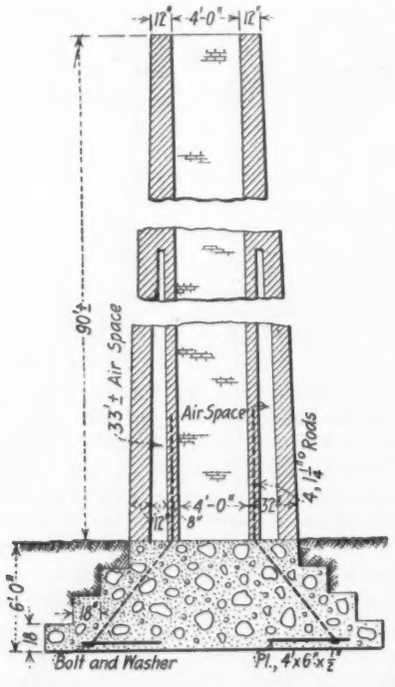
That accidents will happen to water-supply conduits of whatever material was shown in January of this year, when a slide due to wet weather wrecked a short section of the concrete supply main of Victoria, B. C. A reservoir below the break saved the city from having its water-supply cut off. This incident is significant in view of the agitation for a "concrete and steel" pipe line which occurred at Seattle after wood-stave pipe line No. 2 was put out of commission a few weeks ago. At Seattle lack of storage for some parts of the city resulted in cutting off the water-supply for three days. Even duplicate pipe lines were of no avail, because when one broke, the other one was out of commission for repairs. Plenty of storage below the break would have saved much anxiety and considerable expense.

Letters to the Editor

An Old Brick Chimney with a Cantilever Base

Sir—A recent conversation with an old mason and contractor may be of interest to the profession. The substance of it follows:

This mason in 1881 constructed a chimney at English Center, Lycoming County, Pennsylvania, for a tannery. The chimney had a base about 12 ft. square, founded 6 ft. below the surface of the ground, stepped up and in with 18-in. steps, and was of rubble masonry grouted with hydraulic mortar. The superstructure of the chimney was of brick, with walls 32 in. thick at the base,



OLD BRICK CHIMNEY WITH INTEGRAL CONCRETE BASE

tapering to 12 in. at the top—about 90 ft. above the ground. Embedded in these brick walls and foundation were sixteen 1¼-in. round rods, which extended from near the base of the foundation to about 33 ft. above the ground, four rods on each side, situated near the flue and flaring out in the base to correspond with its greater width, as shown in the sketch. These rods engaged iron plates 4 ft. long, 6 in. wide and about ½ in. thick, being secured by bolts and washers.

The reason for having the rods embedded as set forth was that some chimneys in that neighborhood had blown down in high winds. The rods were used to give greater stability, so that the chimney would be the more likely to retain its upright position against the overturning effect of a high wind, the stabilizing effect of the earth-fill being clearly recognized when the chimney was thus bound together in one mass.

The mason's reason for not using concrete was that crushed stone was relatively expensive, explosives and rock-crushing machinery not having reached their present development; and the Rosendale cement used at that time was $2.50 a barrel at the railroad, several miles away. It was not the difficulty of using forms that determined the use of brick, as he asserts that he constructed a reservoir 16 ft. in diameter and 12 ft. deep, the lining of which was concrete 1 ft. thick, with earth embankment on the outside. This concrete lining was placed in 1-ft. layers between circular forms of ½-in. white-pine sheathing, which were raised as the concrete was placed, and fastened for the further placing of concrete.

This certainly looks like an early use of the T-wall section. It is immaterial what is retained in a vertical position. This chimney was surely a retaining wall. It matters not if it were only 6 ft. long; the principle was there just as certainly as if it were 6,000 ft. long. It might be said that it was never loaded or brought into use; but in backfilling, it probably retained even earth in unbalanced heights, and the first wind was a trial or use of the principle.

B. A. Wise,
Bradford, Penn., Feb. 28, 1916. City Engineer.

Lime To Correct Acid Sludge in Imhoff Sewage Tanks

Sir—In your issue of Mar. 2, 1916, is an important letter by W. L. Stevenson, of Philadelphia, reciting experiences at the Pennypack Creek plant, whereby sludge decomposition in Imhoff tanks was benefited by the addition of lime.

I do not doubt the correctness of Dr. Imhoff's views of his experience in the Emscher district, as stated in his article in *Engineering News*, Jan. 13, 1916; but to advise in general against the addition of lime seems to me to be very questionable. It may be that iron or other products in the sewage of the Emscher district may make it unnecessary to add lime there.

Generally speaking, however, the use of lime in many cases may prove most helpful in bringing about proper bacterial conditions within a sludge-digestion chamber where, without such lime treatment, a needlessly long period might be required for establishing satisfactory septicization. This would be true especially in plants where stirring arrangements are deficient or absent for bringing about a mixture of sludge that occasionally after quite long intervals is found to be in an acid and undigested stage.

Different results no doubt follow the decomposition of sewage sludge of varying composition when acted upon by various types of bacteria. What the relative significance may be of different kinds of bacteria and of different ingredients in the sewage solids is a matter upon which we have not complete information. It has seemed to the writer that the predominating types of bacteria rather than the composition of the freshly deposited sludge are of most significance.

This tentative conclusion has been reached as a result of the observation at various Imhoff plants that different compartments, each receiving the same sewage, have during their earlier stages shown quite marked differences in behavior. I agree with Dr. Imhoff that it is necessary to provide proper bacteriological environment. It seems to me that stirring arrangements are highly important and that excessive acidity may arise, particularly in the case of Imhoff tanks receiving domestic sewage, wherein the use of lime for a time at least would prove most beneficial.

GEORGE W. FULLER.

New York City, Mar. 6, 1916.

Early History of the Bone Cantilever Wall

Sir—In your recent article on the Bone retaining-wall patent (Feb. 10, 1916) you make the commendable statement that *Engineering News* has thought it worth while to publish the history of the Bone patent, for the reason that the engineering profession is entitled to know the facts. It is very apparent, however, that a number of the points of history and facts were misrepresented and omitted. In justice to the infringing engineer and to the patentee it seems only proper that the full history of reinforced-concrete retaining walls be set forth from our point of view.

There was a great difference in the early work of Bone on reinforced concrete as applied to retaining walls and that of his contemporaries. Mr. Bone's efforts were exerted in the actual erection of life-sized reinforced walls. The contemporaries and alleged anticipators engaged themselves merely in discussions as to whether a successful device could be constructed and to the obtaining of impractical and "paper" patents. None of the alleged anticipations passed the "limits of mere suggestion of unsuccessful experiment." None of the contemporaries succeeded in devising a structure that anyone ventured to build on a large scale.

Before applying for a patent in 1898, Mr. Bone prepared plans and bid on reinforced-concrete retaining walls for a $20,000 job at Hamilton, Ohio. Although the new type of wall showed a marked saving, the bid was not accepted. From that time on, the inventor endeavored continuously to get plans adopted or bids accepted on his new type of wall. Although a saving in cost could be effected in each case, everyone was afraid of the wall because it looked so thin and seemed so novel. Calculations were presented to show stability. These were verified by numerous experiments with wood models and colored stratified sand to show the action of the retained material. Circulars were sent to the engineers of all important railroads of the United States, explaining the merits of the invention and soliciting opportunities to present designs. In 1899 to 1902, letters were written to a number of the leading consulting engineers of the country, asking for their opinions on the new invention. All complimented the novelty of the device, but for one reason or another were doubtful of its practical utility. These letters were not written for publication, but an excerpt from one may serve to show the view taken by the leading engineers of that time.

The dimensions of your wall and the stresses to which it is subjected, to meet any required case, are open to considerable doubt. As the theory of gravity walls involves too many assumptions to have any value, and as practice is the best guide, this will probably apply to your wall also. I would make several experiments for various heights and see if your theory fits them all.

About the time the patent was granted, an article describing the new wall was sent to *Engineering News*. The article was refused publication on the ground that, being merely a patent, it was of insufficient interest to engineers. The editor stated, however, that if a wall as actually built could be produced, its description might be of interest.

These early efforts show conclusively that, contrary to the claims made by some infringers of the present day, the invention was by no means self-evident to the designing engineer. The leading engineers of the country could not see that it was practical; and the editor of the leading civil-engineering paper could not see that this device, which has now saved the country millions of dollars, was even worthy of discussion. This is no discredit to the leading engineers nor to the well-informed editor. It merely shows the state of the art at that time. It shows that the best technical minds of the day could not see the virtue in a light concrete retaining wall reinforced with steel and that it took more than ordinary vision to foresee its utility.

It was after three full years of effort before the patentee could induce anyone to risk letting him erect the first wall. This wall was built at Black Lick, Ohio, in 1901. It is known as the first reinforced-concrete cantilever retaining wall built in the United States and the first in the world, with the exception of a wall built by J. Lehman in Denmark. Mr. Lehman's wall was of only a moderate height, except a small portion that had a maximum height of 9 ft. The Black Lick wall had a maximum height of 28 ft.

After erecting the first wall, which proved a success, the patentee was hopeful of securing further business. He advertised with renewed vigor on a larger scale, distributing thousands of circulars and pamphlets and offering to prepare plans and grant licenses for a compensation of one-quarter of the saving effected by its use as compared to gravity designs, calculated for equivalent stability. This offer has been standing ever since. Although this should seem very attractive, but little business was secured. The majority of engineers approached seemed loath to have their clients or employers think that any other design could be better or more economical than their own.

Descriptive matter, plans, methods of design, etc., were sent to various patent-bar manufacturers. Some of these manufacturers, with no reply at all, came out in their very next catalog issue with cuts and descriptions of the Bone wall, but with no mention of the inventor or a patent. Later and for many years since, they have advised their customers that the Bone patent was no good. This was in face of the fact that counsel advised them that the Bone patent had an excellent chance of being upheld in the courts. Even some textbooks have unwarrantedly precedented the courts by stating that the Bone patent was probably of little value. All of this was unfair to the infringing designer and to the patentee.

The work secured by the patentee was principally in southwestern Ohio and on small jobs. The accounts of these jobs were distributed throughout the country from time to time by circulars and pamphlets advertising for further business. Accounts of some of this work were

published in periodicals and read in several papers before the Ohio Engineering Society.

Then, after the patentee had promoted his wall for about six years and had demonstrated its efficiency and economy, other engineers began slowly to appreciate its worth. Many of these engineers decided that, with the data and examples put before them, they would make their own plans and avoid payment of royalty. When confronted with requests for royalty, the infringers usually tried to excuse themselves on the ground that the idea was old or that they had gained their idea elsewhere. But when their authorities were traced back, they almost invariably led to the publications originated by Bone himself. The patentee was unable to get compensation for any large jobs. The large infringers defiantly refused payment except by lawsuit. They knew well enough that the patentee was not financially able to fight them in the courts. Even when the patentee made designs and furnished plans by which the walls were built, he could not get compensation from the large infringers. The mere engineering service of preparing the plans for a specific job, however, was not so much of a loss as the years of work spent in convincing engineers of the practicability and advantages of the patented wall, the deriving of new formulas and data for use in design and the risks taken in erecting the first walls.

It became evident very early that, no matter what the engineering service, the patent would have to run the mill of the courts, as is the usual course of patents. The patentee then began to exert himself toward getting financial backing. After two years of endeavor in this line he succeeded in getting some Cincinnati capital to invest, and in 1906 the "Concrete Steel Retaining Wall Co." was incorporated. The object of the company, besides protecting its interests by necessary lawsuits, was to continue on a larger scale the work started by the patentee, both as to designing and contracting for walls. Soon after the company had been launched and a catalog issued and distributed, the moneyed interests withdrew, but business was continued under the same name. The patentee endeavored for six years more to interest capital. Several reorganizations were instigated, but the project finally failed. The discouragements encountered in these attempts at promotion are the same story as the early history of nearly all valuable inventions. The universal arrangement is a scheme of the capitalists in which the inventor is eventually to be squeezed out and all of the fruits to fall to the capitalists.

About 1907, soon after the organization of the Concrete Steel Retaining Wall Co., the company, to advertise itself, did much work toward education in the design of reinforced walls. Education was badly needed. Little, if anything, was to be found in textbooks. Designs were still being made by the old middle-third rule. Little attention was given the economic proportioning of heel and toe. Designs were not adapted to their particular foundations nor were eccentric settlements looked into. In short, designers were following the methods used for gravity walls, which obtained but a part of the advantages of the reinforced walls. The patentee and his associates had devised new theories and formulas adapted to the reinforced wall. These were set forth in catalogs and also, with curves and charts to facilitate their application, were published in periodicals. They have been circulated to anyone interested ever since.

Much of the patentee's time was taken up in attempts to interest capital, but he also individually took contracts for walls in addition to making designs. About 1908 an arrangement was made with the Ferro Concrete Construction Co., Cincinnati, a large contract company, to present bids on retaining walls under license of the patent. This company solicited work from all important railroads in the country, but failed to secure a single job.

In 1912 the patentee received from a contract, for the first time, sufficient profit to warrant bringing a lawsuit and defending his business. The first suit was brought, not against a small infringer, but against a large corporation. It was against the Chicago, Burlington & Quincy Railroad Co., which sent men to Europe to find anticipations. They returned empty handed. The results of this case furnished the first working basis to continue prosecutions against infringers. There have since been a number of suits brought, mostly against large corporations. Most of the cases have been settled out of court. The reason was not because the defendants were unable to stand lawsuits. They were much better able than the patentee. There have been three decisions in favor of the patent and one dismissal. The opinion of Judge Anderson, while frankly against the patent, does not go so far as to hold any of the claims invalid.

The question of anticipation is, from necessity, to be settled only by the courts, and we shall not discuss that; but if the engineer who desires knowledge of the facts will look up and compare the originals of the alleged anticipations as published in *Engineering News*, Feb. 10, 1916, p. 254, some of them will appear in a different light.

When engineers once appreciated the economy and advantages of reinforced-concrete cantilever walls, they could at any time have obtained a license to use the patent. The business methods have always been clearly given in the catalogs issued, and there is no excuse for not taking advantage of the patent license. The catalogs were widely and carefully circulated. It is true that extensive magazine advertisements were not used, and infringements were not at first prosecuted, for the simple reason that the patentee did not have the money to do so. The patentee, not from choice, is now forced to hunt up infringers and make claims to obtain recompense for what he has done and for what he knows he is justly entitled to.

It has been argued that an engineer should devote his invention to the public. The author of such a statement shows his absolute ignorance of what work it takes to bring an ordinary invention into use. When something actually novel is originated, the public does not receive it with open arms. Its merits must be shown and proved. The service rendered in giving the world an invention consists by no means of the mere conception of a thought. Aside from the work of experimenting, it usually costs years of work before the invention is driven into public favor and appreciation. The man who lets his idea drop would do little good compared with the man who works with that idea until some good use is made of it. It would be very gracious for a man to devote years of his labor *gratis*, but an inventor has no more occasion to do it than the ordinary engineer would have to perform his daily work for nothing.

It is a satisfaction to know that the prejudice against patents, among engineers, is by no means unanimous.

There are many fair-minded men of the profession who want to see anyone who has rendered a service paid for it. Whatever the criticisms against the Patent Office system and judiciary methods may be, the case of the Bone patent is one in which the primary object of the patent law is, partly at least, attained. It is, although after many years, giving the inventor a reward for his labor.

EVAN P. BONE,
Frank A. Bone & Son.

Cincinnati, Ohio, Mar. 11, 1916.

[*Engineering News* is glad to give space to this very frank statement. There is no doubt that Frank A. Bone in the beginning believed himself to be the original inventor of the reinforced-concrete cantilever wall and honestly tried to promote its use. His experiences only emphasize the conservatism of the engineering profession and the reluctance of the American engineer for many years to accept and believe in the merits of reinforced concrete. But because most American engineers of 15 years ago were unable to recognize the advantages of a construction already adopted in Europe and described in the European press is no reason why American engineers of today should be made to pay tribute to one who did.

While agreeing with Mr. Evan Bone that the legal aspects of the controversy cannot be successfully discussed in these pages, *Engineering News* must, in answer to some of Mr. Bone's statements, give as its opinion that:

1. A number of the "alleged anticipations" by European engineers did go beyond the "limits of mere suggestion of unsuccessful experiment."

2. Reinforced-concrete cantilever walls were built in Europe before 1901.

3. The Chicago, Burlington & Quincy R.R. did not have to send men to Europe to find anticipations. Records of such anticipations were available in the nearest good-sized library. Furthermore, the railroad's attorneys evidently did not discover the more important anticipations mentioned in *Engineering News* of Feb. 10, 1916.—Editor.]

Will Prosperity Last?

Sir—In *Engineering News* of Jan. 6 the department of Construction News shows what, at first sight, seems to be a very optimistic beginning for the year 1916. In your discussion of the business outlook you pass along the good word one hears on all sides:

> **The spirit of optimism and hopefulness prevails to a degree that has not been apparent for years, and the general belief and expectation is that there will be such prosperity during the year as will recompense the people of this country for all their past misfortunes. . . . Prices on all lines of building material have advanced, with further expected increases when the season opens up in the spring. This is due a great deal to the high price and scarcity of labor.**

In view of this high price of materials, this scarcity of labor and increased cost of delivery it seems that there should be a note of pessimism rather than the opposite.

There is no topic of greater interest to engineers than that of future business prospects and general construction, for in boom times there is a large amount of construction work, necessitating a great deal of technical labor, while in dull times, or financial depressions, the opposite is true. The one means increase of salaries, continuous employment and prosperity, while the other means a nonpaying business or bankruptcy, reduction of salaries or perhaps the very unsatisfactory state of loafing altogether.

The industries of the country have passed from comparative stagnation to tremendous business in less than a year. Our principal industrial product, steel, is being manufactured at a greater rate than ever before. The prices have increased from 50% to 300% in most finished products. Within a few days many inquiries for steel products have been withdrawn because of the high prices. This condition contains the germ of financial depression, for it indicates that the holders of the purse strings will not extend construction work more than is absolutely necessary for maintenance purposes, when prices are at the present level.

Our financial history furnishes instances where conditions were practically the same as at the present time. In 1862 a boom started in which the demand for iron products increased 100% within a few months. It being impossible to supply such a demand, prices rapidly increased. The war, which first depressed business, helped to increase it in 1863 and 1864. The boom reached its height in 1864, when many factories were obliged to close their doors for want of construction material. Investment in new construction almost entirely ceased, but construction for war purposes continued. The price of iron increased from $35 in 1863 to $80 in 1864. At this high point construction material began to accumulate rapidly on all sides, and the price of iron fell 50% in ten months.

People here attributed this remarkable occurrence to the Civil War; but there was no war in Europe in which England, France or Belgium was engaged, yet each of these countries suffered severely from an industrial depression that lasted for several years.

There is a marked similarity between the position of the United States at the present time and that of England and France in 1866 and 1867. Both the Union and the Confederate states purchased at exorbitant rates all the munitions that could be had, causing the price of all construction materials to rise beyond the point where the public would invest in new construction. This situation involved at once a falling off in the employment of labor and a resulting financial depression.

At the present time the influx of gold to pay for munitions—bought at tremendous prices—thereby leaving a large unearned increment in the hands of the favored few, will but temporarily aid in creating prosperity for business as a whole.

The present boom has put construction material nearly up to the price level of 1907, and this has been done within a year, whereas in 1907 three years of expanding business were realized before the crash came. This world war has then produced an economic condition, so far as prices of material and labor are concerned, which would have required from two to five years with ordinary business revivals such as have taken place during the last fifty years. We are, therefore, nearly at the brink of depression and consequent stagnation of all investment in new construction, because of constantly increasing prices largely produced by external causes.

G. L. BILDERBECK.

New London, Conn., Jan. 30, 1916.

Test Data on Loss of Head in fire hydrants of different makes with water flowing through at high rates is desired by Water-Works Superintendent. References to published data or brief summaries of unpublished information would be welcome.

Keeping Open a Mexican Railway

EDITORIAL CORRESPONDENCE

No better example of the tenacity of American engineers could be found than the keeping open of the Southern Pacific Ry. of Mexico during the last five years. During all the troubles of that unfortunate country this railway has never been out of operation for over two weeks at a time. It is operating today (Mar. 9) all sections of the Southern Pacific and the Sonora Ry. except a 120-mi. section running from Rosario to Tepic. One group of revolutionists and brigands after another has burned bridges and caused destruction until, as Vice-President and Chief Engineer L. H. Long told the editor, what is left is a "pretty bum road," so rough and rugged that on a recent trip he jokingly remarked that from the front platform of his car one could always see the locomotive either over or around the other cars. Nevertheless, the railway is passable for both freight and passengers.

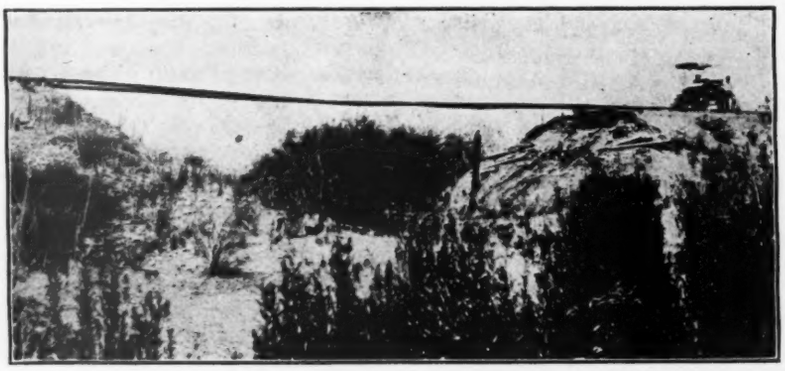


FIG. 1. BRIDGE ON SOUTHERN PACIFIC OF MEXICO BURNED BY VILLISTAS IN JUNE, 1915

A few of the larger bridges, like that shown in Fig. 2—the Yaqui River bridge—have not been destroyed, doubtless because it would have required too much energy. But every structure that would burn has been burned, and this included in some instances the substructures of steel bridges. The great majority of the bridges destroyed have been timber trestles, varying in length from 15 to 1,575 ft. The aggregate length of bridges destroyed between December, 1910, and Mar. 1, 1916, has been 75,151 lin.ft., including 71 openings. Of this, 5,945 ft. was work that has been destroyed more than once.

Fortunately, all the streams crossed are dry in all except the rainy season, so that to keep the railway in operation, instead of attempting to rebuild the ruined structures, as was done at first, the plan is now to detour around the old crossings and dip down into the river bottoms with as little grading and bridging as possible. The part of the roadbed carried away by floods is cheaper to replace than that destroyed by brigands.

In their experience with the numerous *de facto* governments of Mexico the Southern Pacific Co. officials have preserved a strictly neutral attitude, recognizing whatever individual or group of individuals happened to be in power, although this frequently meant that different parts of the line were under different jurisdictions. There has been but little interference with the actual operation of the railway, and but very few employees have been killed except in actual battle, when they had enlisted under one of the current commanders.

The various marauding bands have become very expert in the destruction of property, particularly of railway property, and have learned most of the tricks of the better-trained, though hardly more experienced, troops of the past. One of their pet performances, in fact, was well known in the Civil War. This is the total annihilation of the railway track, not only by tearing up rails and ties, but by using the ties as material for a bonfire in which the rails are heated red hot and when in that condition twisted around nearby telegraph poles or trees. The restoring of a line so destroyed is a man-sized job.

Apparently, however, there has been little of the dynamiting of the larger more solid structures such as has been so common in the present European War, and the results of which have so often been pictured.

FIG. 2. YAQUI RIVER BRIDGE OF THE SOUTHERN PACIFIC OF MEXICO

One of the few large structures which have not been destroyed

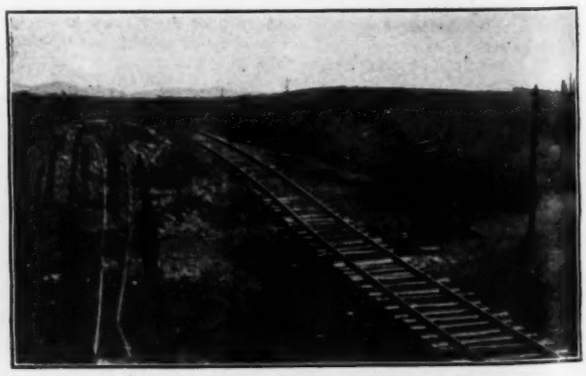


FIG. 3. DETOUR THROUGH RIVER BOTTOM AROUND BURNED BRIDGE

Dry stream beds are used instead of rebuilding bridges

Detroit Sewer Wrecked by Gasoline Explosion

On Sunday, Mar. 12, 1916, at about 9 p.m. the Scotten Ave. sewer in Detroit was wrecked by an explosion of gasoline vapor, and the pavement overhead was ripped up for a length of over 2 mi. The detonation was severe and was plainly heard for 15 mi. Residents of Scotten Ave. were thrown off their feet, and several were shaken out of bed, but only three persons were injured. The street was paved with brick on a concrete foundation, and at places slabs were thrown up, as shown in the accompanying illustration. At two places the city water mains were broken, and nearby cellars were flooded. A dock near the outlet of the Scotten Ave. sewer was set on fire by burning gas. The damage to the city has been roughly estimated by Commissioner of Public Works George H. Fenkell at $500,000. The Scotten Ave. sewer was built in the years from 1888 to 1908 at a total cost of $93,800. The explosion was caused by the escape of some 10,000 gal. of gasoline from a tank-car on a private siding of the Raths Oil Co. Had it not been for the facts that most of the sewers in Detroit are located in streets extending at right angles to the river and that there are some fifty odd outlets into the Detroit River, the distribution of the gasoline vapor would have been wider and the damage from explosions would have been much greater.

The tank-car that caused the trouble was the property of the German-American Car Co., Farrell, Penn. It was built in 1913 and was leased to the Wabash Refining Co., Robinson, Ill. The tank was stenciled to show that it had been tested to 60-lb. pressure and that the safety valve had been tested to 12 lb., but the dates of inspection were not stenciled. The leakage was through the outlet valve located under the center of the tank bottom. This had been capped, but the cap was fractured by freezing of trapped water. The leakage was at a rate about one-fifth of full discharge.

The valve was removed after the tank was freed of gas, and it was found that a 5/8-in. bolt had been embedded in the lead seat of the nozzle, so that the valve could not completely close.

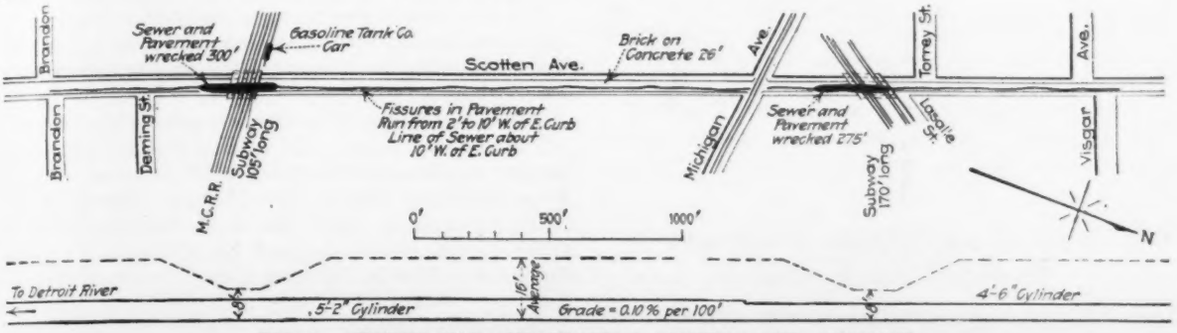


FIG. 1. SKETCH MAP AND PROFILE, SCOTTEN AVE., DETROIT

FIG. 2. RESULTS OF SEWER EXPLOSION AT SOUTHERLY CROSSING UNDER MICHIGAN CENTRAL R.R.

FIG. 3. PAVEMENT UPHEAVAL NEAR LA SALLE ST.

News of the Engineering World

Rapid-Transit Railway System for Cincinnati

Plans for the new rapid-transit railway system in Cincinnati were advanced another stage on Mar. 14, when the City Council passed an ordinance submitting to popular vote on Apr. 25 the ordinance for the issue of $6,000,000 bonds to build the proposed system. Preliminary surveys for the rapid-transit system were made by F. C. Edwards and Ward Baldwin in 1914. Their surveys included a belt line around the city, with a loop in the business district. About 6½ mi. would be built as a subway.

National Septic Process Protective League

The National Septic Process Protective League was formed at Des Moines, Iowa, on Mar. 14, 1916. About 35 delegates were present, from Iowa, Kansas, Minnesota and Ohio. Dr. H. M. Bracken, Minneapolis, secretary of the Minnesota State Board of Health, was elected president, and F. G. Pierce, Marshalltown, Iowa, secretary-treasurer. The object of the league is to defend all suits filed against its members for the infringement of Cameron septic-tank patents. All municipalities, corporations, companies and individuals interested in sewage disposal are eligible to membership, subject to the approval of the executive committee, upon the payment of the proper fee.

Prof. A. Marston, Ames, Iowa, discussed the development of septic tanks and the litigation in regard to the claim of the Cameron Co. for royalties. R. E. Sampson, assistant attorney general of Iowa, explained the legal status of the Cameron claims, especially in the light of the recent decision against the City of Winchester, Ky.

Following a general discussion, a committee was appointed to report upon a plan of organization. The committee brought in the following resolution, which was adopted:

Whereas, The Cameron Septic Tank Co., of Chicago, is making demands upon municipalities throughout the United States for the payment of excessive royalties, on account of a certain alleged patent which it claims to own; and,

Whereas, This conference has been advised by able attorneys that in their judgment the alleged patent of the Cameron Septic Tank Co. has already expired and that it is no longer a live and valid patent upon which royalties can legally be collected; and,

Whereas, It is the judgment of those from the several states represented in this conference that the interests of the taxpayers and general public can best be protected by contesting the validity of said alleged patent, by ascertaining the scope of its valid claims, if any there be, and by refusing to pay any and all royalties to the said Cameron Septic Tank Co., on account of said patent, until after the courts of final jurisdiction have upheld the validity of such patent and the liability for such royalties; and

Whereas, The expense of defending suits of this character would prove burdensome to a single municipality; and,

Whereas, The benefits which would accrue from such a suit, if successfully contested, would prove of value to all of the municipalities from which royalties are being demanded and particularly to the taxpayers of such municipalities; now, therefore, be it

Resolved, That the National Septic Process Protective League be, and the same is, hereby formed for the purpose of aiding in the defense of any suit brought by the Cameron Septic Tank Co. against any municipality, company, corporation, state institution or private individual which is a member of this league, when such suit involves the validity of said patent.

The membership fees for cities are graded by thousands of population, as follows: Under two, $10; two to five, $15; five to ten, $20; ten to twenty, $25; twenty to fifty, $30; over fifty, $35.

There will be two directors for each state. Those so far chosen are: Iowa, Dr. J. F. Cole, president Iowa League of Municipalities; Lafayette Higgins, engineer State Board of Health, Des Moines. Kansas, C. A. Haskins, engineer State Board of Health, Lawrence. Ohio, W. H. Dittoe, engineer State Board of Health, Columbus. Illinois, Langdon Pearse, assistant engineer Sanitary District of Chicago; Paul Hansen, engineer State Board of Health, Urbana. California, W. J. Locke, secretary League California Municipalities; Charles G. Hyde, consulting engineer State Board of Health, Berkeley. Minnesota, H. A. Whittaker, assistant engineer State Board of Health, Minneapolis; G. A. Gsell.

It is interesting to observe, as brought out in the discussion, that the alleged infringements of the Cameron septic-tank patents are not confined to what are frankly called "septic tanks," but extend "to those which employ putrefactive reduction of sewage solids, but which for purposes of evasion have been styled 'sedimentation' or 'settling tanks,' as well as to the more recently exploited 'Imhoff' or 'two-story' septic tank."

It is further important to notice that the terms for licenses are 3% per annum on the original cost of the complete plant and subsequent additions, "including" (to quote from a letter signed by Mr. Wyllie, of the Cameron Septic Tank Co.) "the tanks, contact beds, filters or other appurtenances, for the number of years each plant has been in operation to date of settlement, plus an additional 3% for the remaining unexpired term of the patent."

Water-Supply and Sanitation Are Big Military Problems

To secure a safe and adequate water-supply and safely to dispose of all wastes are the greatest problems of military camp making is what was told the audience at the sixth of the New York City engineers' military lectures, Mar. 20. Tactical considerations fix the location of camps for an army in action, but otherwise engineering considerations prevail—good water, dry ground, presence of wood, grass and forage, location of roads and railroad facilities. The best ground has a tough turf over a porous subsoil. An old camp ground should not be reoccupied for two or three months.

The army field regulations provide standard camp plans—which usually cannot be followed except as to preserving organization units, widely separating kitchens

from latrines and pickets, etc. The engineer troops are sent ahead to lay out the camp and are accompanied by representatives of each organization to guide the forces to designated places. One battalion of engineers is allotted to an army division, but it is given other troops for labor. Where the camp is by a stream, the various water-supplies are taken out in the following order from upstream down: Drinking and cooking, watering horses, bathing, laundry. Guards are immediately posted to secure observance of these limits.

When the main body arrives, the first work is to set up the kitchens; then the latrines are built. The third work is getting in water and wood, and finally main tents are pitched.

In most cases it is necessary to purify the water-supplies—by heat, filtering or chemical action. The Forbes regenerative sterilizer has been adopted in America in small and large units, producing 15 and 300 gal. per hr. and using 1 and 20 qt. of oil fuel per hour. The Darnell mechanical filter, devised by the Army Medical Corps, is highly regarded. It requires a tank, two cans, a siphon filter and cloth; alum and sodium carbonate are used as the precipitant. Only 5 min. is required to set up, and 2 or 3 to start operation; 98% bacterial reduction is secured plus good clarification.

In disposing of wastes sewers are usually impracticable. Garbage is always burned—preferably in a stone-lined incinerating pit. For fecal matter simple pit latrines are most used and gradually filled in with the excavated dirt. The McCall portable incinerator, however, is widely used; with this the wastes are received in pans over the firebox (cold except when cremating).

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Frozen Concrete and Poor Design Cause Failure

A reinforced-concrete roof that was being placed in the remodeling of the old Memphis Brewing Co.'s building for a storage warehouse for the Paterson Transfer Co. at Memphis, Tenn., collapsed on Mar. 6 and injured two men who were caught under the débris. The roof was designed by the architect in charge of the remodeling of the building. It covered an area of 26 ft. 4 in. by 67 ft., with beams spanning the short side on 12-ft. centers.

The slab was 4 in. thick, with ⅝-in. round rods on 12-in. centers, and the beams were 7 in. wide by 8 in. deep under the slab, with four 1-in. square twisted bars all in the same horizontal plane. Two were bent up at each end 5 ft. from the support, at about 30°, and then ran horizontal to the support; the other two were straight for the full length. There was a 1-in. square twisted bar about the under side of the slab for a length of 20 or 22 ft. through the center. This apparently was to tie the stirrups over. These stirrups were ¼-in. rounds spaced on 12-in. centers.

The concrete was poured Feb. 6, and the forms were stripped on Mar. 6. The roof collapsed just after the forms were taken out. The highest temperature for February was 71° on the seventeenth, and the lowest after the roof was poured was 25° on the fourteenth, the mean for the first week being 46°. The low on Feb. 6 was 36°; on Feb. 7 it was 30°, and Feb. 8 it was 29°, the mean for all of February being 42.5°. The concrete after the failure was very crumbly and could easily be broken with the hand. With such shallow beams underreinforced and with concrete that did not properly set up, there seems to be no problem as to why the roof collapsed.

The roof had a pitch of 8 in. toward the north. In falling, it pushed out the south brick wall, which fell into the street, and the whole roof moved about 18 in. to the south and fell in badly shattered condition on the old floor beneath, which held under the impact.

The work was in the way of repairs and minor alterations and was apparently being carried on without permit from the building commissioner. A local engineer is now engaged in revising the design for better construction. It is the first reinforced-concrete failure that Memphis has had.

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Code of Ethics for Western Society of Engineers

A committee of the Western Society of Engineers has recently presented a draft of a proposed code of ethics for adoption by the society. The committee was made up of Hiero B. Herr, chairman, John W. Alvord, C. R. Bart, P. Junkersfeld and C. F. Loweth. The code which the committee has drafted differs materially from the codes adopted by other engineering societies in that it consists of a statement of general principles instead of a statement of definite acts which are enjoined or forbidden.

The committee has studied the codes of ethics which have been adopted by other engineering societies, and its chairman prepared a compilation embodying the principal points of all these codes. After examination of this compilation the committee decided that "the general ethical principles and ideas as to the relations and conduct of the engineer cannot be effectively incorporated in a set of fixed rules universally applicable. . . . The best guide to correct detailed professional relations would be a keen appreciation of the general professional status and a conscientious attempt to be guided in each specific case by the spirit of the ideas set forth." Based on these ideas, the committee has formulated a brief statement of the basic principles underlying all professional ethics, which it believes sufficient for the needs of the society and recommends for adoption. The first part of the proposed code deals with the position and duties of professional men in general. It lays stress on the fact that the member of a profession uses knowledge for which he is indebted in great degree to the profession as a whole. The code then presents suggestions as to the duties which the engineer, as a professional man, owes by virtue of what he has received, as follows:

A. He can lead an honorable and upright life.

B. He can regard the profession as a fraternity and act on this theory.

C. He can lose no opportunity to improve his professional information to the end of bettering his service to his employer or his client.

D. He can uphold the dignity of his profession by cheerfully giving credit to his contemporaries for their good work and avoiding all envy or petty jealousy.

E. He can do his share in supporting societies created for professional benefit and contributing when possible to their store of useful knowledge.

F. When confronted with the necessity of honorable competition with professional brethren, it should be entered into with the utmost courtesy and consideration for all concerned and, to say the least, without public exhibition of greed, self-laudation, jealousy or ill-humor. Some degree of honorable and courteous competition among professional men is often inevitable, particularly for salaried positions, and at times

in all except the higher class of consulting work. This being so, the courtesies and ethics of competition should be studied and cultivated with especial care to the end that the fraternal feeling in the profession does not suffer. Competition in professional work, where it enters in at all, should always be on the basis of efficiency in service offered and never, knowingly, in price concessions.

G. The engineer should always assure himself, as far as possible, that the professional services he renders are in value reasonably in excess of the salary received or fee charged. Where he is in position to fix his own fee, the utmost conscientiousness about charges is to be observed.

H. He can be a "gentleman" always and everywhere. He can follow the "Golden Rule."

The code then takes up the specific duties of the engineering profession and, after explaining the responsibility which lies upon the engineer as a professional man, enumerates some of the responsibilities and duties of the engineer toward the public, as follows:

A. In all engineering problems the public safety ranks first and is above all other considerations.

B. In the development of the art of engineering it is incumbent upon the engineer to educate the public up to a right perception and appreciation of engineering problems.

C. The engineer should always stand ready to voice publicly, safety and security and sound economics in the public administration of engineering.

D. Service to the public, directly or indirectly, is the appropriate and natural opportunity of the engineer, and that it is even less well paid than private service is perhaps in part due to the fact that the engineering profession is indebted to the public primarily. Public service is therefore a peculiarly honorable service and should be especially respected.

E. General engineering advice may in certain emergencies and with reason and caution be appropriately tendered to the public without charge, but not to the prejudice of careful investigations where necessary, or to the discouragement of inquiry requiring ample funds, or to the cheapening or discrediting of the public problem in hand.

The final paragraph of the code sums up its principles and precepts as follows:

The ethical standards of the engineering profession should be those of a fraternity. The engineer should recognize that he is endowed by the profession and the state with specialized knowledge for peculiar, judicial and responsible public service involving the life, safety, comfort and convenience of his own and coming generations, and that in response to these he should so conduct himself as to be appreciative of his indebtedness to his profession for his opportunity and make return by every effort by a life of special usefulness devoid of unseemly greed and filled, if possible, with a multitude of those small courtesies the practice of which encourages the spirit of forbearance and is helpfully conducive to the fine art of living well together.

Another Thacher Patent Suit

A suit for infringement of United States Patent 617,615, issued to Edwin Thacher on Jan. 10, 1899, "for new and useful improvements in concrete arches," against the Transit Construction Co., New York City, was decided against the plaintiff by Judge Thomas in the United States District Court for the Southern District of New York on Jan. 8, 1916. The bridge in question is the Ashokan bridge of the Board of Water-Supply at Olive, N. Y. The case was decided upon the distinction between dependence and independence of the intrados and extrados reinforcing rods in the bridge.

The first main claim of the Thacher patent is as follows:

The combination with abutments and a concrete arch spanning the intervening space or a series of metal bars in pairs, one bar of each pair above the other near the intrados and extrados of the arch and extending well into the abutment, each bar of a pair being independent of the other substantially as described.

It was brought out in the trial that the original Thacher claims were repeatedly rejected by the Patent Office examiner, and Patent No. 545,301, issued to one Milliken on Aug. 27, 1895, was cited as a reference. The Milliken patent relates more to building construction than to bridges, but appears to contain all the elements of the Thacher patent—namely, abutments, an arch, a series of metal bars in pairs, upper and lower bars and bars extending well into the abutment. In the Milliken patent, however, the upper and lower bars are connected by means of metalwork. Following the Patent Office's rejection of the Thacher claim, Mr. Thacher finally submitted his claims with the added phrase, "each bar of the pair being independent of the other."

In the Ashokan bridge the upper and lower longitudinal reinforcing bars not only are connected by the usual stirrups, but they were firmly fastened by bolts and clamps to a number of transverse frames made up of structural shapes. The judge ruled that the connection between the crossframes and the arch bars is direct:

The arch bars are directly bolted to the angle-iron crossframes by heavy bolts at the bottom and top, and these bolts are drawn up very tightly so that the upper bars cannot move perceptibly without producing a corresponding movement in the lower bar, the connection between each upper arch bar and its corresponding lower bar being effected by several iron fastenings called stirrups. . . . The result of this arrangement is that each upper bar is firmly connected to the corresponding lower arch bar by angle-iron frames at several different points and by stirrups at ten more points.

The judge further states that this distinction between dependent and independent must be regarded as material in determining the question of infringement. He therefore ruled that the bill of complaint be dismissed. The judge further states that due consideration in reaching this result has been given to the opinion of Judge Rose in Thacher vs. Mayor, etc., of Baltimore, 219, Fed., 909, in which the claims in controversy were sustained. The question here involved was not before the court in that suit, as appears from the opinion. The question there involved was mainly of patentability, and it was held that the patentee had done something which his predecessors in the art had not and that the difference between the patent and the charged infringement (which did not involve in any way the dependence or independence of the bars upon each other) was substantially the same as that of the patent in suit.

Panama Canal To Be Reopened

Col. Chester Harding, Acting Governor of the Panama Canal, made the following announcement on Mar. 15: "Conditions in Gaillard Cut justify prediction that canal will be available for ships of 30-ft. draft on April 15, subject to probable temporary delays thereafter to meet exigencies of dredging fleet in completing canal to full width and depth and in removing shoals that may possibly develop."

A Break in the Concrete Water-Supply Conduit that brings Sooke Lake water to Victoria, B. C. (see "Engineering News," Nov. 18, 1915, p. 994), occurred on Jan. 22, 1916. An earth slide, due to wet weather, took place at the top of a steep embankment; and 12 lengths, or 48 ft., of pipe were carried about halfway down the slope, where they lodged. Six lengths were broken. As the pipe line was not readily accessible, temporary repairs were effected by cutting timber in the vicinity and utilizing boards from an old camp for a timber flume. Repairs were completed in about three days. As soon as the weather permits, C. H. Rust, city engineer and water com-

missioner of Victoria, writes under recent date a concrete trestle will be built and enough pipe will be molded on the spot to repair the break permanently. The only previous break on this pipe line occurred last fall, when owing to a forest fire, a large pine tree fell across the conduit, breaking one length of pipe and cracking three more. There was no water shortage during the time the water was shut off in January, as the rainy weather afforded an ample supply from the Humpback Reservoir, with a capacity of 150,000,000 U. S. gal., besides which the city last year tapped two large creeks on the line of the conduit.

A **Small Car Fell** from the 12th St. shaft of the Mill Creek sewer, St. Louis, on Mar. 16, killing one man at the bottom of the shaft. Just previous to the accident the car was being loaded with bricks on the street surface at 12th St., when it broke loose, ran downgrade and tumbled into the shaft. The men working at the bottom heard warnings, but two of them were struck by the falling bricks. The accident apparently was due to blocking the car improperly.

The Building Code of St. Paul, Minn., is being revised by P. E. Stevens, Consulting Engineer of St. Paul. Mr. Stevens' work will be reviewed by a committee made up of members of the Civil Engineers Society of St. Paul, the Architects Club and the Builders Exchange.

A Fire-Retarding Zone in Nashville, Tenn., is included in the revised building code which, according to local reports, is practically certain to be adopted by the Board of Commissioners. The zone covers a large area in which all buildings of a height of four stories or less shall be of either fireproof or mill construction. Buildings of a greater height shall be fireproof. The credit for this provision is due the Nashville Section of the Engineering Association of the South. The association sought to have all the buildings in this zone made fireproof, but owing to the opposition of real-estate men, architects and carpenter-contractors, this was prevented.

Plans for a New Terminal of the Pennsylvania R.R. in Pittsburgh are reported to have been approved by the engineering department. An expenditure of $5,000,000 is contemplated; it is expected that the directors of the road will in a few weeks order the work to proceed. A big porte-cochère on the present station will give way to a 12-story office-building addition. The steel will be designed for 22 stories. The passenger-service rooms will be lowered 15 ft., and two train levels will be used—suburban below and through-line above. Electric traction will be required for the lower level; and until the electrification of the suburban lines is undertaken, the lower level will not be used for trains.

The Committee on Safety Standards of the Pennsylvania Industrial Board held a public hearing in the North American Building, Philadelphia, Mar. 16, to consider portions of the code that will govern installation of elevators in Pennsylvania, excepting cities of the first and second class. The committee that approves safety devices met in Harrisburg, Mar. 21, to consider 30 different mechanical appliances submitted as safety devices. No safety device may be used in Pennsylvania unless approved by this committee, which includes James C. Cronin (chairman), Otto T. Mallery, Lew R. Palmer, Richard M. Pennock, Dr. Francis D. Patterson, John S. Spicer, Oscar E. Thompson and William Lauder, secretary.

The One-Hundredth Anniversary of the organization of the United States Coast and Geodetic Survey will be commemorated by a banquet at 8 p.m. on Apr. 6, at the New Willard Hotel in Washington, D. C. The speakers will be the President of the United States, the Minister from Switzerland, the Secretary of the Navy, the Secretary of Commerce and Dr. Thomas Corwin Mendenhall. On this day and the preceding, centennial exercises will be held at the new National auditorium. In three sessions 14 addresses will be made. An exhibit will be held at the New National Museum, consisting of surveying instruments and appliances, pictures of surveying operations and equipment; charts and other publications of the bureau.

Extensive Municipal Improvements at Harrisburg, Penn., having been completed, the Board of Public Works, which carried out the improvements, resigned on Mar. 14. From the proceeds of a loan authorized in 1902 a water-filtration plant was built at a cost of about $325,000; a sewerage system was improved at a cost of $365,000, and a dam across the Susquehanna River was built at an expenditure of $83,000. A 1905 loan of $367,000 paid for the Mulberry St. bridge across railway tracks and Mish Run and 18th St. and met the cost of further sewer construction. A loan of $334,000 in 1910 enabled the board to construct the Paxton Creek open sewer and an intercepting sewer along the bank of the Susquehanna River and also river-bank protection, at a total cost of $334,000. The board consisted of Edwin C. Thompson, D. E. Tracy and J. W. Bowman. It served without compensation.

The Sewage-Disposal Problem of Montclair, N. J., has been referred by the Town Council to fifteen resident engineers, who are given power to add to their number. All branches of the profession, including editors of several engineering journals, are represented on the committee, which has been selected in order that the town may avail itself of the services of an advisory committee of the "large number of public-spirited engineers of high standing" who live in this suburb of New York. Some years ago, Orange, East Orange and Montclair decided not to join the Passaic Valley Sewerage District in its trunk-sewer project, with disposal in New York Bay. Plans for a disposal plant for the three communities were drawn by Hering & Gregory, New York City, and approved by the State Board of Health. This project has been delayed for various reasons, and there has been considerable talk of separate action by the three communities named.

Philadelphia Rapid-Transit Plans have been curtailed in the modifications announced by W. S. Twining, the present Director of Transit (who recently succeeded A. M. Taylor). The Broad St. subway will be built only from Erie Ave., on the north, to Spruce St., on the south, instead of from Olney Ave. to League Island navy yard. This is a total reduction of about 60 blocks in length. The old plans called for four tracks to City Hall, a delivery loop and two tracks beyond. The new plans call for four tracks from Erie Ave. to Ridge Ave., 4,500 ft. north of City Hall, then two tracks to and under City Hall and to Spruce St. The delivery loop will be partly built as two tracks going south on Ridge Ave. from Broad St. to 8th and to Market St., thence south to Walnut and west to 16th, where they will dead-end for the present. The Broad St. line and the loop will be on different levels at Broad and Walnut St. The Frankford elevated line (to the northeast) will be built to Bridge St., but the Roxborough elevated and subway (to the northwest), the Darby elevated (to the southwest) and all extensions will be left for the distant future. The Keystone Construction Co. has a contract for $1,700,000 of work, a large part of which will not now be done.

The Breaking of the Valve of a gasoline storage tank belonging to the Petroleum Products Co., Neville St., Pittsburgh, on Mar. 10, liberated a great quantity of gasoline, which flooded the surrounding district. Several employees were overcome by the fumes. The gasoline flowed to the sewers and called for quick work on the part of the employees of the Department of Public Works and of the company in lifting the lids from all manholes on the 33d St. sewer between the tank and the river, to allow the fumes to escape. Traffic on the Junction R.R. tracks of the Baltimore & Ohio R.R. was suspended for a time, for fear a spark from an engine might ignite the gasoline fumes. The flow of gasoline was stopped by pumping water into the tank, which displaced the gasoline at the bottom and raised it above the level of the cracked valve. It was along this 33d St. sewer that the disastrous sewer explosions occurred last year in Pittsburgh, and one of the most plausible theories advanced at that time was that gasoline fumes had collected in the sewer from the waste of garages and commercial establishments. There were a dozen or so explosions in homes and sewers of another section of Pittsburgh—the Soho district—earlier in the month, which were generally credited to the leakage of natural gas, although the coroner stated that he would recommend that gasoline waste from garages and other plants be excluded from sewers.

A Contract for Wood Paving Blocks for Minneapolis, calling for 350,000 sq.yd., was awarded on Feb. 28 by K. T. Alexander, city purchasing agent. The blocks will be of yellow pine, 3½ in. deep, creosoted with 16 lb. of oil per cubic foot. The contract price for the blocks is $1.46 per yard, and the contract is divided equally between the Republic Creosoting Co. and the Kettle River Co. The latter shaved its price ⅞c. per sq.yd., to meet the best bid of the Republic Co. Each of the two bidders offered lower prices on half than on the whole contract, under an option given in the advertisement. The price paid by Minneapolis for blocks in 1915 was $1.32. The advance in the 1916 over the 1915 price is said to be less than the increased price of lumber, oil, etc. J. L. Weatherly, of the Kettle River Co., says that the value of the total order will exceed $511,000, strips included, and that the blocks will require 1,000 cars for transportation, will be equivalent to 12,250,000 ft. b.m. of lumber and will pave 22 mi. of 27-ft. roadway. The blocks will be laid by day labor, in accordance with the well-known Minneapolis practice. The cost of the greater part of the 1916 paving will be met under the Elwell law, which makes it possible to allow payments in annual installments extending to as many as 20 years. The maximum under the old law was 5 years. E. R. Dutton, assistant city engineer in charge of paving, is arranging with the Civil Service Commission to increase the number of paving employees from the 400 of last year to 800 or more for the coming season.

PERSONALS

Mr. R. W. Jamison has been appointed City Engineer of Alameda, Calif.

Mr. William R. Roy has resigned as State Highway Commissioner of Washington, on account of ill health.

Mr. George S. Clemens, Pottsville, Penn., has been appointed Consulting Engineer of the Reading Coal and Iron Co., which is a newly created position.

Mr. C. E. Lewars has been appointed Superintendent of the Lebanon, Steelton and Dunbar, Penn., plants of the Semet-Solvay Co., to succeed W. Walley Davis.

Mr. S. B. Fisher, formerly Chairman of the Valuation Committee of the Missouri, Kansas & Texas lines, has been appointed Consulting Engineer of the Missouri, Kansas & Texas Ry.

Mr. Charles H. Swigart, formerly Supervising Engineer of the United States Reclamation Service, has been elected General Manager of the Yakima Valley Fruit Growers' Association.

Mr. Aaron Lloyd has been appointed Superintendent of Construction on the new state bridge at Spring City, Penn., by the Pennsylvania Board of Public Grounds and Buildings.

Mr. Chester A. Hogentogler, formerly Engineer for the Borough of Columbia, Penn., has been elected Assistant Professor of Civil Engineering at the University of Idaho, Moscow, Idaho.

Mr. Charles E. Barba, Assistant Engineer in the Mechanical Department of the Pennsylvania R.R. at Altoona, Penn., has resigned to become associated with the Midvale Steel and Ordnance Co.

Mr. F. Herbert Snow, M. Am. Soc. C. E., Chief of the Engineering Division of the Pennsylvania Public Service Commission, has been made professional lecturer on public utilities at Pennsylvania State College.

Mr. J. R. Nichols has been appointed Manager of the new office of the Asbestos Protected Metal Co., in the Hurt Building, Atlanta, Ga. Mr. Nichols has been associated with the company for a number of years at its Chicago office.

Mr. James B. Walker, formerly Assistant Secretary of the New York State Public Service Commission for the First District, has been appointed Secretary of the commission, in the place of Travis Whitney, who is now a member of the commission.

Mr. G. O. Case, M. Am. Soc. C. E., Chief Engineer of the Case Coast Protection Corporation, New York City, sailed on Mar. 4 for Georgetown, British Guiana, for the purpose of making a report to that Government on the erosion of the country's coast.

Mr. B. J. Dalton, M. Am. Soc. C. E., formerly Assistant District Engineer, Division of Valuation of the Interstate Commerce Commission, has been appointed Chairman of the Valuation Committee of the Missouri, Kansas & Texas lines with headquarters at Parsons, Kan.

Mr. Charles Enzian, M. Am. Inst. M. E., formerly Mining Engineer of the Anthracite District of the United States Bureau of Mines at Wilkes-Barre, Penn., has been appointed Mining Engineer of the Shenandoah and Mahanoy division of the Reading Coal and Iron Co.

Mr. A. C. Shields, formerly Division Engineer of the Chicago, Rock Island & Pacific Ry., at Little Rock, Ark., has been appointed Division Engineer of the Missouri division, with offices at Trenton, Mo. He succeeds F. E. Watson, who has been granted a leave of absence.

Mr. T. R. Galey has been appointed Manager of the new office of the Asbestos Protected Metal Co., of Pittsburgh in the Praetorian Building, Dallas, Tex. Mr. Galey has been associated with the company for the past four years, two of which were spent at the Beaver Falls factory.

Matthew J. Scammell, Superintendent of Blast Furnaces at the Sparrows Point, Md., plant of the Maryland Steel Co., has been made General Superintendent, a position formerly held by Quincy Bent, who has been made General Manager at the Steelton, Penn., plant of the Pennsylvania Steel Co.

Mr. Albert A. Northrop, M. Am. Soc. C. E., formerly of the firm of Seabury & Northrop, New York City, and more recently Supervising Engineer of Stone & Webster, will sail on Apr. 1 for Montevideo, Uruguay, where he will be connected with the construction of sewage-disposal and water-supply systems for several cities in Uruguay. His headquarters will be at Montevideo.

Mr. Paul Hansen, M. Am. Soc. C. E., for the last few months Acting Chief Engineer of the Illinois State Board of Health, has been appointed Chief Engineer. Mr. Hansen is a graduate of the Massachusetts Institute of Technology. He has been successively Assistant Engineer of the Ohio State Board of Health, Engineer of the Kentucky State Board of Health and Chief Engineer of the Illinois State Water Survey. His headquarters will be at Springfield, Ill.

Mr. R. Boone Abbott, Division Engineer of the Philadelphia & Reading Ry. at Harrisburg, Penn., and President of the Engineers' Society of Pennsylvania, has been appointed Superintendent of the Shamokin division of the road, with headquarters at Tamaqua. Mr. Abbott entered the service of the Philadelphia & Reading in 1900. Soon after he was made Assistant Supervisor at Tamaqua and after various promotions became, in 1910, Division Engineer at Harrisburg.

Mr. Robert N. Hoyt, for the past two years administrative officer at Wellesley, Mass., in the experiment whereby adjoining towns combine in the establishment of a high-grade health office to serve them all, has been appointed Health Officer of Manchester, N. H. Mr. Hoyt was formerly Biologist of the Metropolitan Sewerage Commission of New York City and, later, for a time was Health Officer of Princeton, N. J. Mr. Hoyt graduated from the Massachusetts Institute of Technology in 1909.

Mr. James Allen, Chief Engineer of the Washington State Highway Commission, has been appointed State Highway Commissioner to succeed Mr. William R .Roy, who has resigned. The position pays $5,000 a year. Mr. Allen has been Chief Engineer since 1913, previous to which time he was locating engineer in the State Highway Department (in 1909) and later Chief Engineer of the Olympia Light and Power Co. Mr. Allen has also been connected with the Oregon Short Line R.R., the Northern Pacific Ry., the Missouri Pacific System and the Chicago, Milwaukee & St. Paul Ry.

Mr. C. B. Lamont, M. Am. Soc. M. E., Manager and Consulting Engineer of the Skinner-Eddy Corporation of Seattle, has resigned as Manager of the company and opened offices in the Hoge Building, Seattle, where he will practice as a consulting engineer. He will continue as Consulting Engineer of the Skinner-Eddy Corporation and in addition to his consulting work in the shipbuilding line will conduct a shipbrokerage department. Mr. Lamont, previous to his association with the previously named concern, was Assistant to the President of the Seattle Construction and Drydock Co.

Mr. George F. Cotterill, former Mayor of Seattle and former member of the state senate, has been appointed Chief Engineer of the Washington State Highway Commission to succeed Mr. James Allen. The position pays $3,600 a year. Mr. Cotterill has lived in Seattle since 1883. He is a charter member and was the first secretary of the Northwest Society of Engineers. He was Assistant City Engineer from 1892 to 1900, during which period he did a considerable amount of work in the development of the city water-supply. In 1902 he became a member of the firm of Cotterill & Whitworth and in 1910 dissolved partnership and specialized for many years in park and landscape platting. He was Mayor from 1912 to 1914.

Mr. Sydney O. Swenson, M. Am. Inst. E. E., for the past four years Electrical Engineer of the Kansas City Terminal Railway Co., in charge of all electrical work pertaining to the new union station and terminal facilities, has become a member of the Engineering Offices of Putnam A. Bates, 2 Rector St., New York City. Previous to his work at Kansas City Mr. Swenson was Assistant Electrical Engineer of the Detroit River Tunnel Co. and was engaged on all engineering work in connection with the electrification of the Michigan Central R.R. at Detroit, Mich., and Windsor, Ont. After graduation from the University of Illinois in 1899 he spent six years in the engineering department of the Commonwealth Edison Co. of Chicago and later was engaged on the electrification of the New York Central R.R. at New York City.

OBITUARY

George A. Gilfillan, M. Am. Soc. C. E., Consulting Engineer of Pittsburgh, Penn., died at Battle Creek, Mich., on Mar. 13. He was 51 years of age.

Carl G. Eyssell, President of the M. Eyssell Construction Co., St. Louis, Mo., died in that city on Mar. 10, at 26 years of age. Mr. Eyssell recently succeeded his father as President of the company.

Charles Jephtha Hill Woodbury, M. Am. Soc. M. E., Consulting Engineer, of Boston, died at his home in Lynn, Mass.,

on Mar. 20, at 64 years of age. Mr. Woodbury was a graduate of the Massachusetts Institute of Technology. He was Engineer, and later Vice-President, of the Manufacturers' Mutual Fire Insurance Co. In 1894 he was made Assistant Engineer of the American Bell Telephone Co. and remained with the company until 1907. Mr. Woodbury was Manager of the American Society of Mechanical Engineers from 1882 to 1885. He was Secretary of the National Association of Cotton Manufacturers.

Frederick C. Stevens, who has appointed Superintendent of Public Works of the State of New York by Ex-Governor Hughes, died at his home in Attica, N. Y., on Mar. 14. Mr. Stevens was elected state senator in 1902. He served as Chairman of the joint committee appointed to investigate the operation of the New York City gas and electric companies and selected Mr. Hughes as counsel for the committee. Following the successful outcome of the investigation by the committee, Mr. Hughes was appointed counsel of the insurance investigation, and upon his election as Governor of New York State he chose Mr. Stevens as Superintendent of Public Works. Mr. Stevens was 64 years old.

Robert M. Jones, an engineer of Denver, Colo., died suddenly on Mar. 1 at Carlsbad, N. M. He was born in Wayne, Ohio, in 1853 and began his engineering career as a United States Deputy Surveyor in locating township and territorial boundaries, principally in New Mexico, Indian Territory and Wyoming. For this work, in 1880, he applied the Burt solar attachment to the engineers' transit and patented the Jones latitude arc for observing latitude at any time of day. In 1883 Mr. Jones became associated with the Edison Electric Illuminating Co. and built a steam plant at Laramie, Wyo., and in 1889 went to Salt Lake City, where he built the three original systems and steam-power plant. He also built two electric-railway systems in Montana. He invented and for a short time manufactured an electric rotary diamond drill. During the 1893 panic Mr. Jones financed and began constructing the Big Cottonwood "Stairs" hydro-electric plant to supply power to Salt Lake City, which is still operating as part of the Utah system. He located and partly constructed the first plant of the Nevada-California Power Co. on Bishop Creek, Calif., for supplying power to the Goldfield and Tonopah mining districts in Nevada. Since 1906 Mr. Jones had maintained an office in Denver, acting as engineer in examination and design of many hydro-electric projects throughout the West and in Mexico. For several years past he had devoted much of his time to the development of a process for making hollow reinforced-concrete poles, piles and pipe without the use of forms. At the time of his death Mr. Jones was engaged in making repairs on the Tansill dam on the Pecos River at Carlsbad.

ROBERT M. JONES

William Howatt, who designed and supervised the construction of the belt-line tunnel of the Baltimore & Ohio R.R. at Baltimore, Md., died at Youngstown, Ohio, on Mar. 16, at 74 years of age. He was born near Glasgow, Scotland, and educated in the University of Edinburgh. He came to America in 1866 and settled in Braddock, Penn. His first service was with the old Pittsburgh & Connellsville R.R. He later became Chief Engineer of the Pittsburgh division of the Baltimore & Ohio R.R. After the completion of the belt-line tunnel Mr. Howatt was Chief Engineer and Superintendent of Public Works of Braddock, in which position he remained for 17 years, and then he returned to the Baltimore & Ohio, remaining with that railroad for six years. About 10 years ago he was appointed head of the Public Works Department and Borough Engineer of Braddock, resigning two or three years ago.

Erasmus Darwin Leavitt, M. Am. Soc. M. E., died at Cambridge, Mass., on Mar. 13. He was born in Lowell, Mass., in 1836 and was educated in the Lowell public schools. He served for three years as apprentice in the machine shop of the Lowell Manufacturing Co. and was for one year with Corliss & Nightingale. He was later Assistant Foreman of the City Point Works in South Boston and had charge of building the engines for the flagship "Hartford." From 1859 to 1861 he was Chief Draftsman for Thurston, Gardiner & Co., Providence, R. I. He served through the Civil War, during which period he was detailed to the Naval Academy at Annapolis as instructor in steam engineering. In 1867 he resumed the practice of mechanical engineering, specializing in pumping and mining machinery. He was Consulting Engineer of the Calumet & Hecla Mining Co. from 1874 to 1904, during which time he designed and superintended the equipment now used at Calumet. He was also Consulting Engineer for Henry R. Worthington, the Dickson Manufacturing Co. and the Cities of Boston and Cambridge and designed the pumping engine for the City of Louisville, Ky. He was advisory and designing engineer for the Bethlehem Steel Co. and several South African mining companies. Mr. Leavitt was President of the American Society of Mechanical Engineers in 1883 and was a member of numerous other national and international technical societies. In 1884 he received the honorary degree of Doctor of Engineering from Stevens Institute of Technology. He retired from active practice in 1904.

Lightner Henderson, Chief Engineer of Purdy & Henderson, Civil Engineers, died at Chicago, on Mar. 17. He was born at Lancaster Gap, Penn., in 1866. In 1889 he graduated from Lehigh University. He worked as structural-steel draftsman and designer until 1891, when he was employed by C. T. Purdy, Consulting Engineer, Chicago, two years later being taken into partnership. Among the prominent structures the design of which was vitally influenced by Mr. Henderson, are the Flat Iron, Whitehall, Metropolitan Tower, Waldorf-Astoria, Hippodrome, Pennsylvania R.R. Station in New York City, New York County building, Marquette building, Montgomery-Ward Tower, Congress Hotel of Chicago, University Club of Chicago, Wabash Terminal of Pittsburgh, New Willard Hotel of Washington, Jefferson County Savings Bank of Birmingham (Ala.) The exposed steelwork in the Concourse of the Pennsylvania Station (New York), the design of which steel was conceived by Mr. Henderson, probably is the most generally admired piece of structural work in the country. C. T. Purdy, his partner, speaks of Mr. Henderson thus: "He had an exceptionally fine analytical mind, and judgment always reliable. He possessed, more than any other man in the country, the faculty of combining theoretical analysis with consideration for the practical, which is so necessary to the highest development in structural-steel designing. He was gifted with a genius for simplicity, coupled with accuracy and reliability. In his relations with other men, right was his primary objective. He was beloved by associates and employees." Mr. Henderson was a member of the Western Society of Engineers and of the Engineers' Club, Chicago. He is survived by a widow and two daughters.

ENGINEERING SOCIETIES

COMING MEETINGS

AMERICAN ROAD BUILDERS' ASSOCIATION.
Feb. 28 to Mar. 3. Annual convention in Pittsburgh. Secy., E. L. Powers, 150 Nassau St., New York City.

ENGINEERING SOCIETY OF WISCONSIN.
Feb. 25-26. Annual meting in Madison. Secy., L. S. Smith, Madison, Wis.

CONFERENCE ON ENGINEERING CO-OPERATION.
Apr. 13-14. Conference in Chicago. Secy., C. E. Drayer, Cleveland, Ohio.

AMERICAN CHEMICAL SOCIETY.
Apr. 18-21. Annual meeting at the University of Illinois, Urbana-Champaign. Secy., Charles L. Parsons, Washington, D. C.

Engineers' Society of Pennsylvania will hold its second annual banquet at the Harrisburg Club on Mar. 25. The banquet will be in celebration of the twelfth anniversary of the founding of the society, which now has a membership of nearly 800. Henderson Gilbert, Harrisburg, will be toastmaster, and the speakers will be as follows: A. T. Dice, vice-president and general manager of the Philadelphia & Reading Railway Co.; Frederick W. Fleitz, former deputy attorney general of Pennsylvania; Colonel Biddle, of the United States Army Engineer Corps; J. V. W. Reynders, former vice-president and general manager of the Pennsylvania Steel Co., and Quincy Bent, general manager of the Steelton plant of the Pennsylvania Steel Co., formerly assistant to President F. W. Wood of the Maryland Steel Co. The keynote of the addresses will be "Preparedness" from the industrial and engineering viewpoint. The committee in charge includes, Charles E. Ryder, chairman; Mier G. Hilpert, R. L. Gillespie, H. P. Drake, Henry S. Evans, George S. Relae, W. Gard Conklin, William McCreath, Edward J. Bevan and R. Boone Abbott, president of the society.

Appliances and Materials

Motor Tractor with Towing Winch

A new design of tractor, known as "Model 36," has been put out by the Knox Motor Associates, Springfield, Mass., the special feature being a powerful winch on the rear of the tractor frame for use in wrecking, hoisting, logging or heavy haulage over bad ground. Except for the added features incidental to towing and winch haul and use with four-wheeled trailers only, this tractor is like the earlier "Model 35" described in "Engineering News," Mar. 11, 1915, with hydraulic brakes, locking differential, etc.

The winch is equipped with 150 ft. of cable and is driven from a power attachment on the transmission through a propeller shaft and two universal joints to a worm and gear on the winch shaft. The winch drum is loose on the shaft and is driven through a clutch that may be released by hand when it is desired to reel off the cable. With the motor running at 1,000 r.p.m. the cable is hauled in at 40 ft. per min. When it is desired to operate the winch, it is of course necessary to anchor the tractor itself; and to supply this anchorage, a heavy sprag is attached to the rear axle. The tractor

KNOX TRACTOR WITH TOWING WINCH

can tow in either direction. At the rear of the tractor frame a large forged-steel towing hook is attached, and a heavy buffer spring is inserted to absorb the shock of sudden starting. Two front hooks enable towing backward or anchoring the tractor in addition to use of the sprag. The tractor chassis is designed to support a weight of from 2 to 4 tons in any form of body that may be desired, thus insuring the necessary degree of traction and enabling the tractor to act as a carrying as well as a hauling vehicle. Steel wheels are also provided at small additional cost, either as a substitute for the standard rubber-tired wheels or as extra equipment.

Where the tractor has to haul a heavily loaded trailer or a train up an abnormal grade, the trailer wheels can be blocked, the tractor run ahead 150 ft. and anchored by the sprag; a 20,000-lb. drawbar pull exerted through the winch can then be utilized to bring up the load. In bad going the winch may also be used to pull the tractor or trailer up on solid ground when either has become mired. The price of this machine is $5,000.

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Bituminized Paving Brick

Under the trade name "Aspha-Bric" there is being brought out a paving brick saturated with bituminous compound. The bricks are ordinary side-wire-cut vitrified, with a minimum crushing strength of 3,500 lb. per sq.in. In the process of being bituminized they are piled on pallets, run into a preheating chamber (400° F.) for 2 to 4 hr., transferred to a truck and run into a large pressure tank. Here they are subjected first to a 25-in. vacuum for 1 hr. and then covered with melted asphalt (350° F.), which later is subjected to 160-lb. pressure for 2 hr. Finally, the asphalt is run off, and the bricks are cooled under pressure.

Standard rattler tests of these treated bricks were run at the University of California and showed a loss of 8.3%. The absorption was 0.3% after 24 hr. submersion. Heating to 225° F. for 48 hr. showed no weight loss. Analysis of a sample of pulverized brick showed 11.2% bitumen. The total cost of these bricks, as produced at Oakland, Calif., is reported to be $10.20 per M. It is claimed that the treated bricks resist abrasive wear better and have a better bond to each other and to their foundation than the untreated. The process is controlled by the Aspha-Bric Corporation, 540 Otis Building, Chicago.

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Inkwell for Drafting Pens

An inkwell with a valve point for filling the drafting pen, designed to save time and simplify the operation by making it a one-hand movement, is made either as illustrated or with two wells on a common base casting. It has a porcelain well basin, with a hard-rubber valve case screwed into the lower

DRAFTSMAN'S INKWELL

part. The valve is a pointed plunger pushed downward by a light spring. When pushed up by the draftsman's pen, it lifts a small quantity of ink and then allows this to run down around the plunger point to fill the pen. The Allen Co., 221 Columbus Ave., Boston, is the maker of this device, called the "Quickfil" inkwell; the cost is $2 single, $3.75 double.

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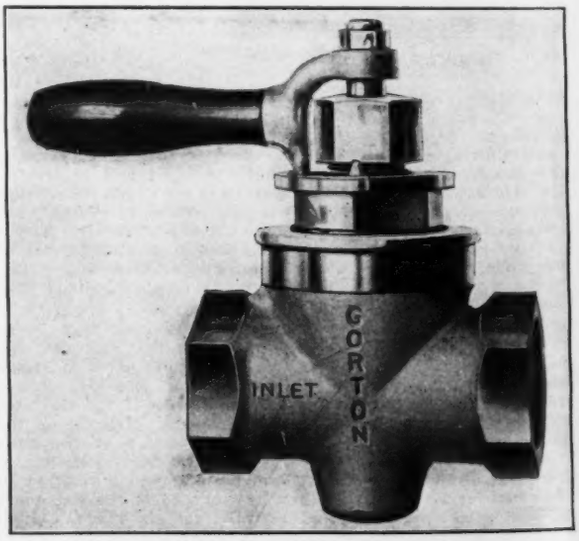
Radical Departure in Valves

A new departure in the design of steam and water valves has been developed by the Gorton-Lidgerwood Co., 96 Liberty St., New York City. The new type is adapted for all services, but work has been completed as yet only on the ½- to 1½-in. straightway and radiator valves. The body is of bronze ("steam metal") reamed to receive a ground taper plug of a special molded mineral composition which, it is claimed, is indestructible and has no temperature or service distortion. A full-sized through port is molded in the plug, and a quarter turn opens or closes. The plug is held to its seat by a bronze spring under the cap or bonnet. The valve stem engages the plug through a loose joint, to prevent possible unseating. No packing is required for the stem, but a molded asbestos ring in a simple gland is used as added precaution.



GORTON QUARTER-TURN VALVE

The large size and free way of the steam or water passage allow the use of a size smaller valve than is customary in many cases. Valves of this type are made to sell at standard list prices (running from $2.40 for a ¾-in. straightway to $6.60 for a 1½-in.) in small quantities, but can be produced in large numbers to compete with the older types.